



Physiology of Nervous Sytem

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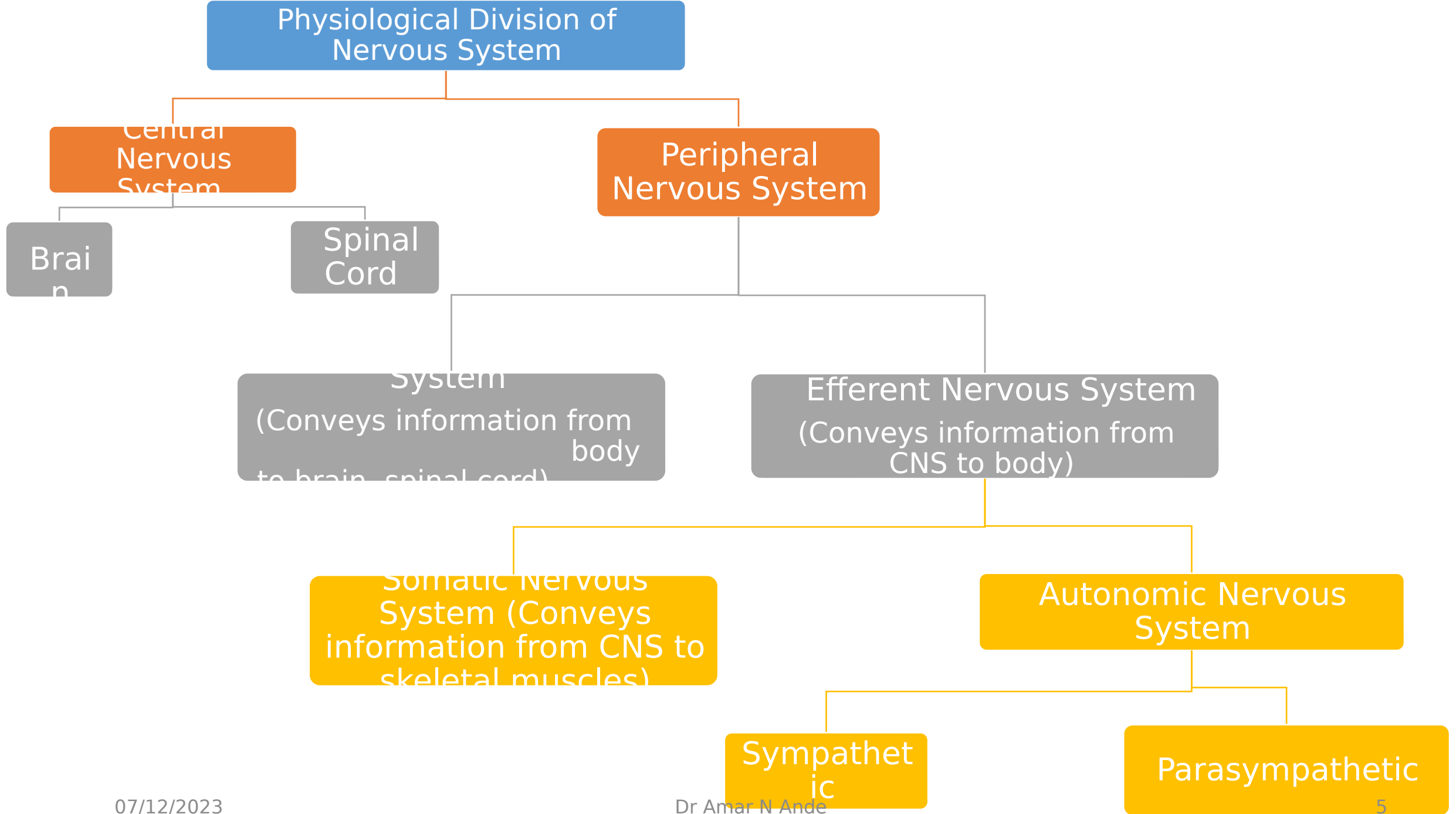


Objectives

1. General introduction to nervous system, neurons, mechanism of propagation of nerve impulse, physiology of CNS,PNS, ANS.
2. Physiology of sensory and motor nervous system, functions of different parts of brain and physiology of special senses, intelligence, memory, learning and motivation.
3. Physiology of speech and articulation.
4. Physiology of temperature regulation.

Physiology of Nervous System

- System which transmits messages and coordinates various body functions is called as nervous system.
- Let us begin with general introduction to nervous system.
- Physiological Division of Nervous System is as follows-

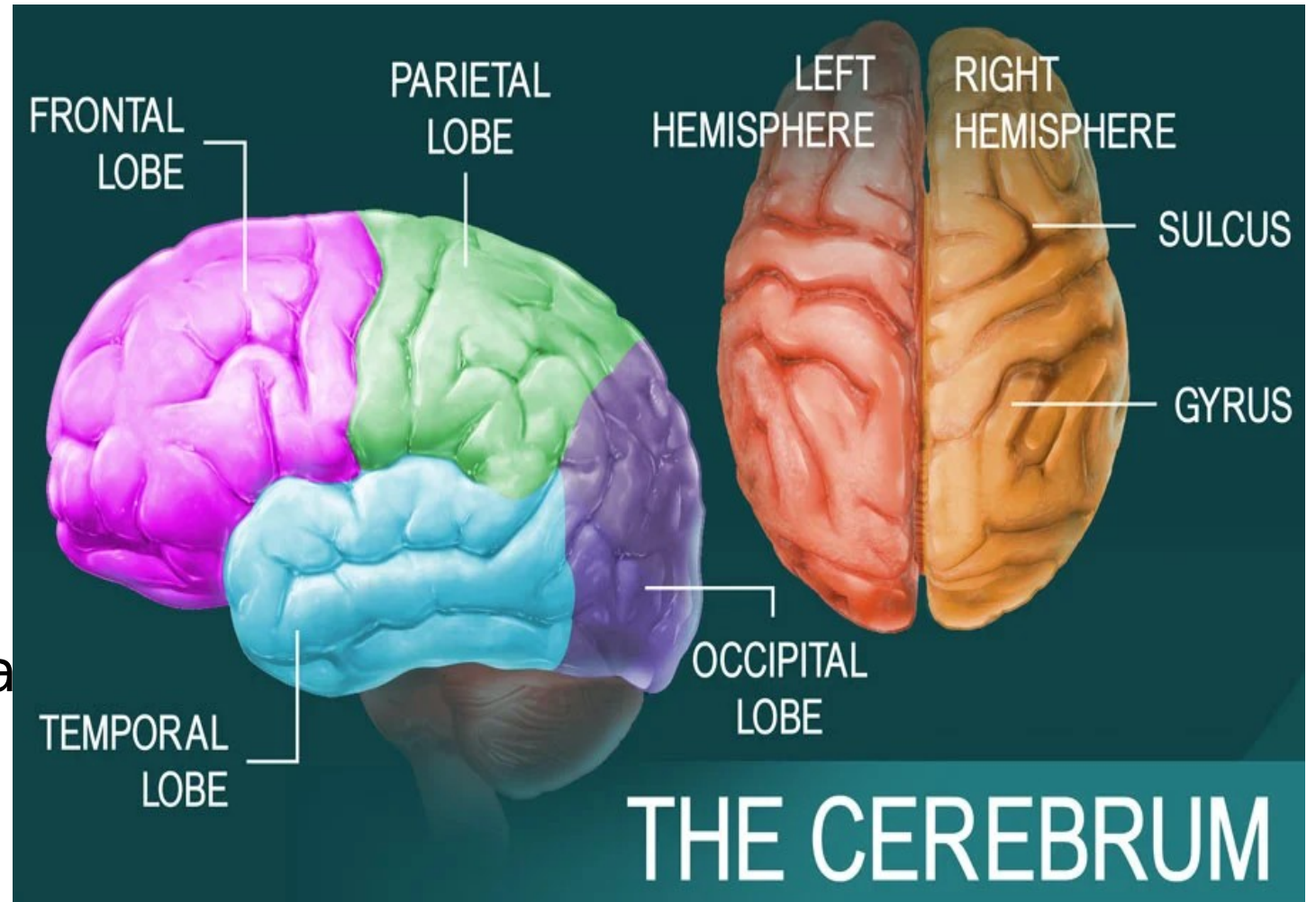


Physiology of Central Nervous System

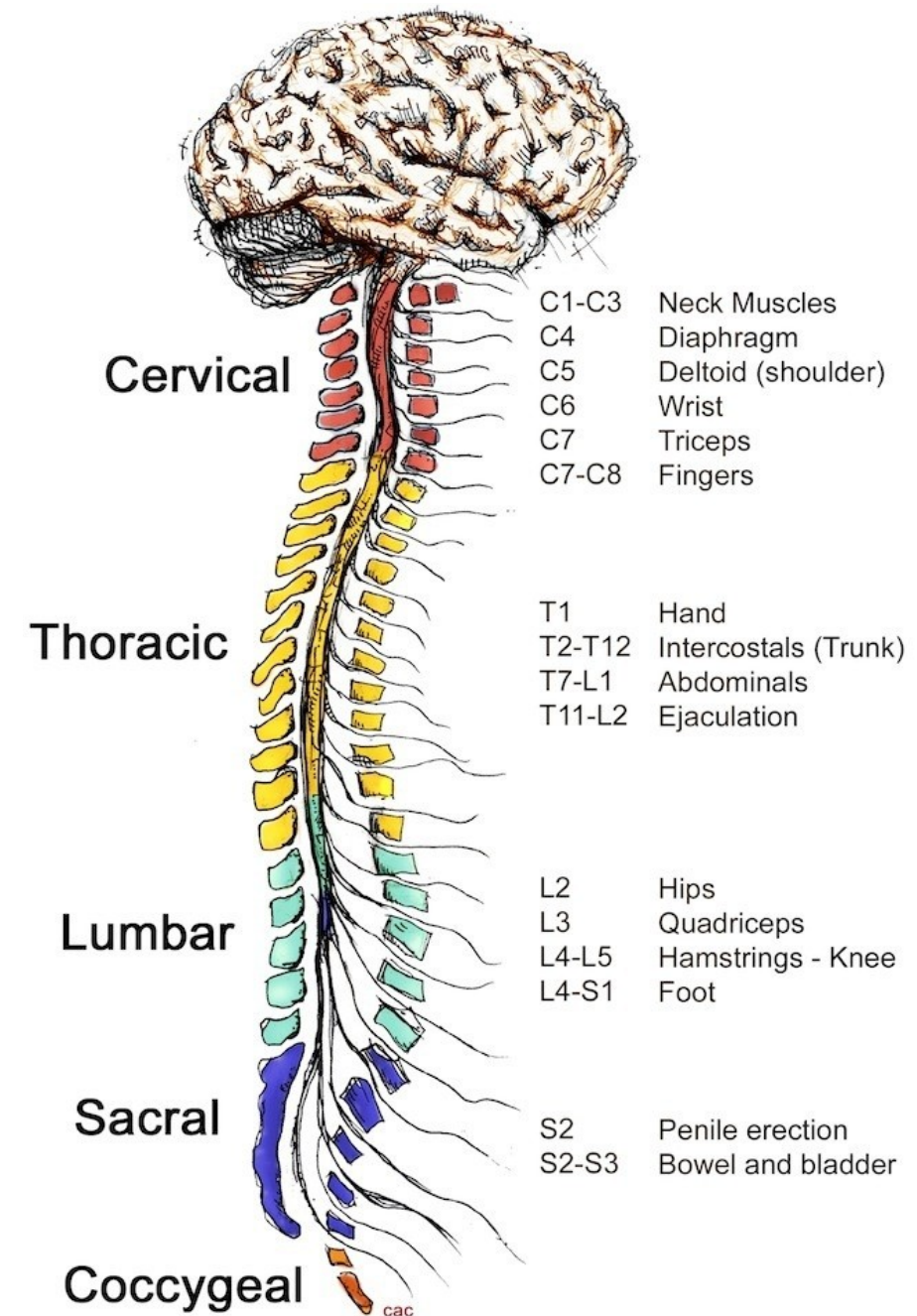
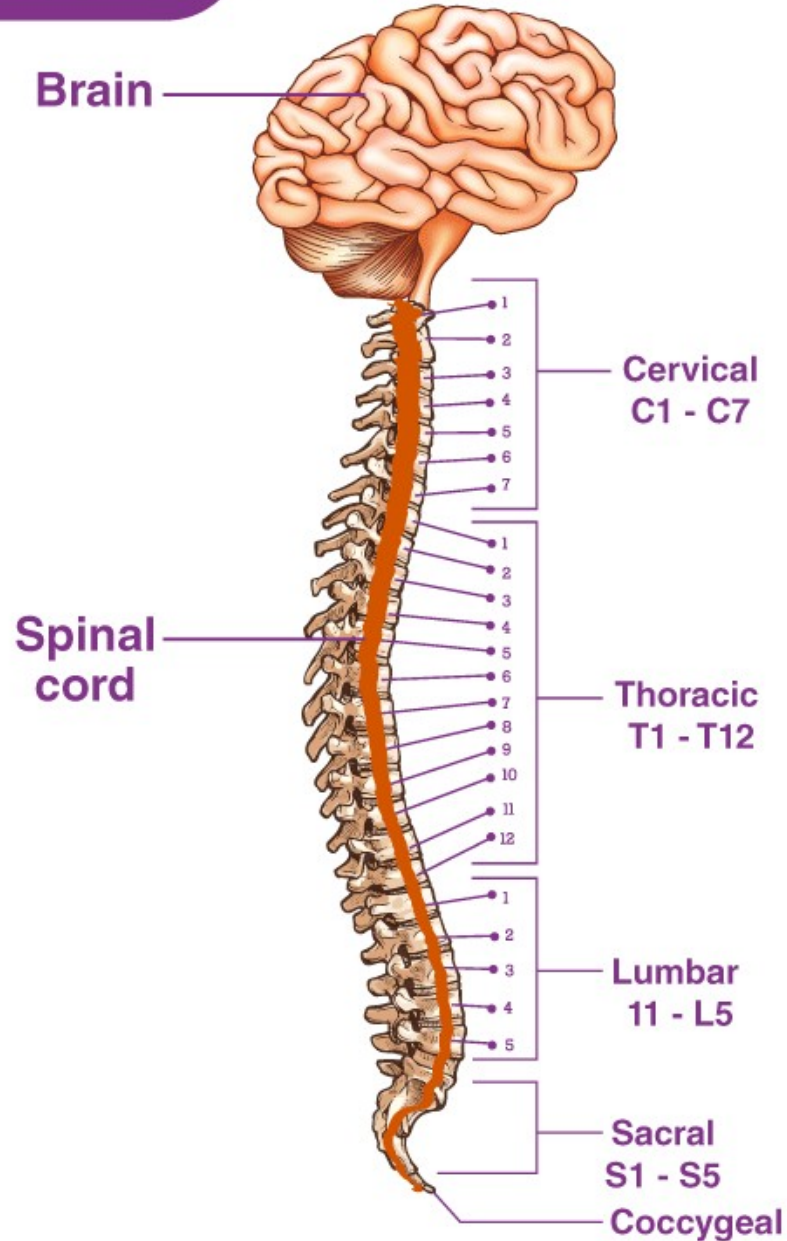
Central nervous system consists of brain and spinal cord.

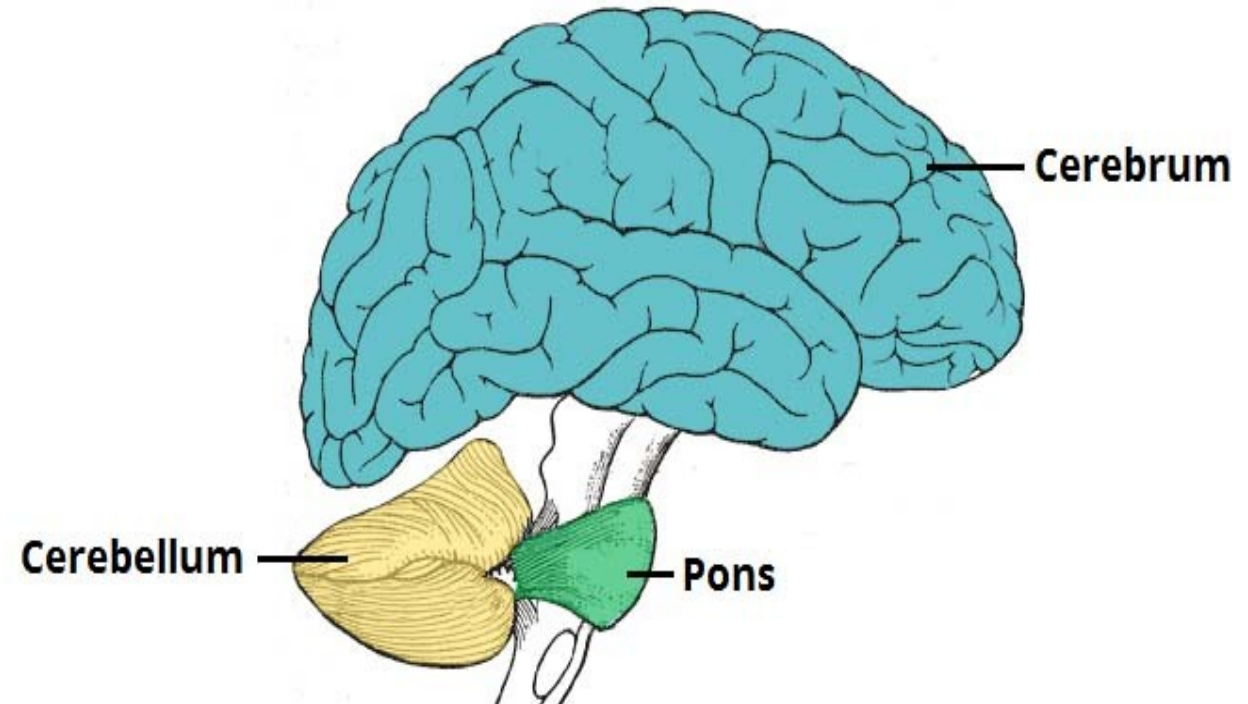
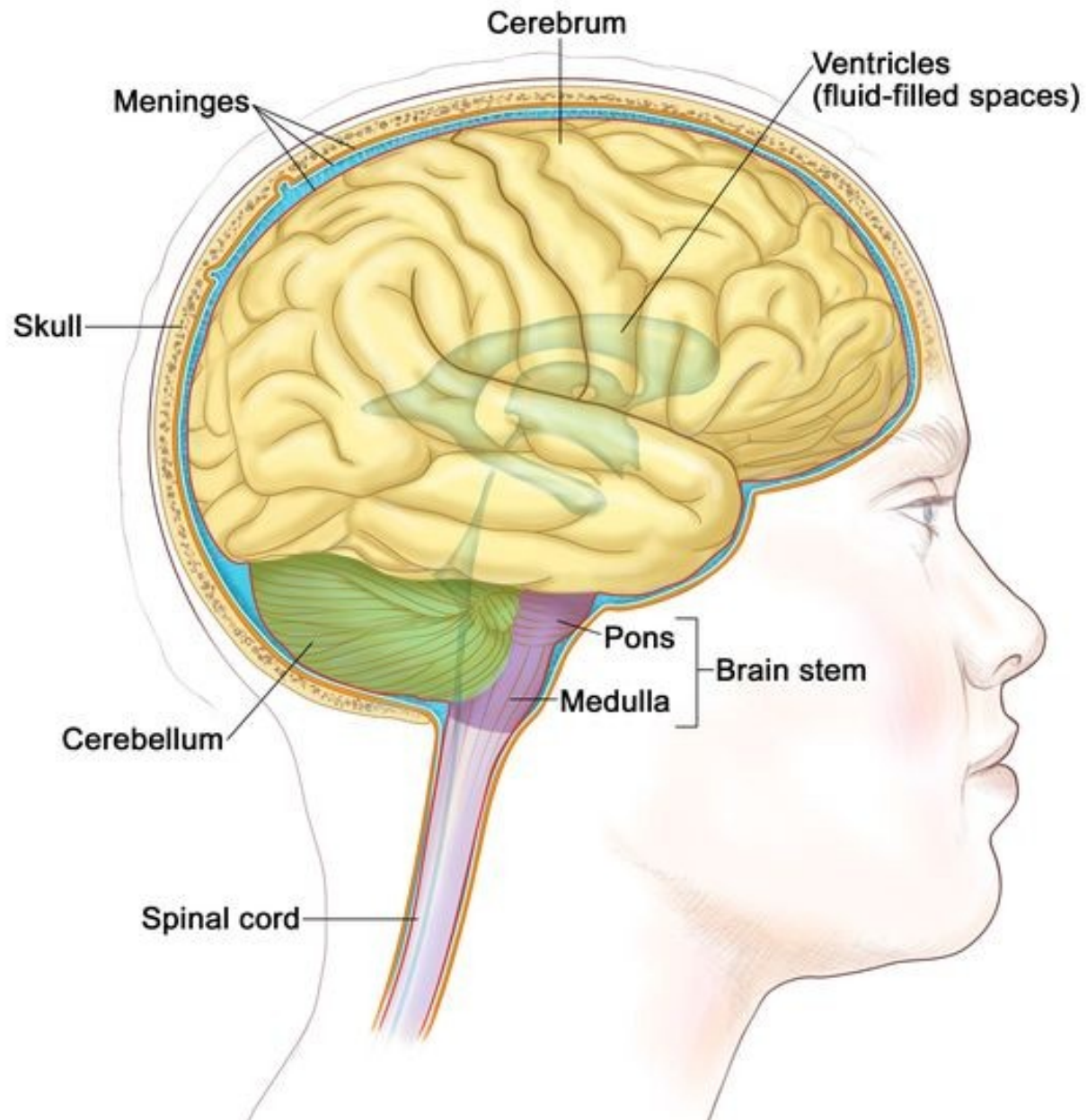
Parts of Brain

1. Cerebrum
2. Cerebellum
3. Diencephalon
 - I. Thalamus
 - II. Hypothalamus
4. Brain Stem
 - III. Medulla Oblongata
 - IV. Pons
 - V. Mid Brain

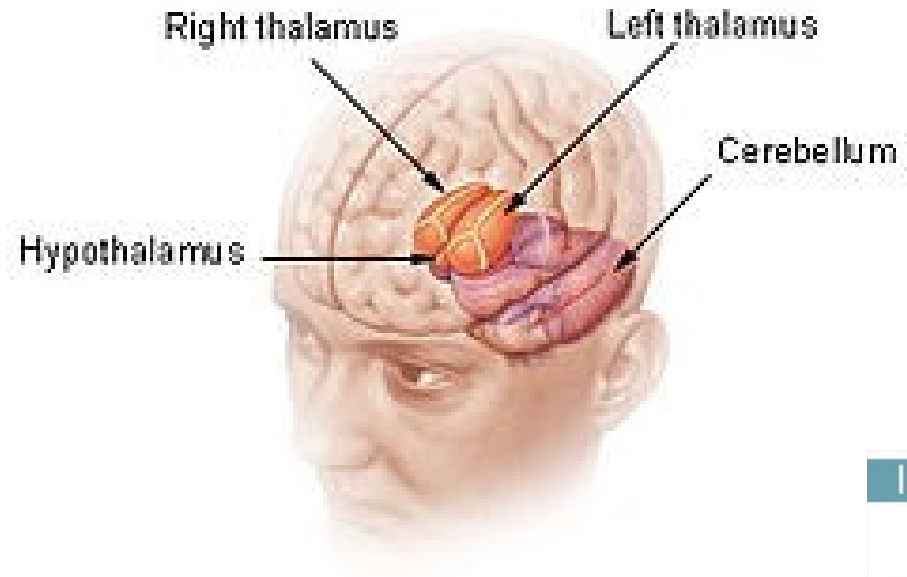


SPINAL CORD

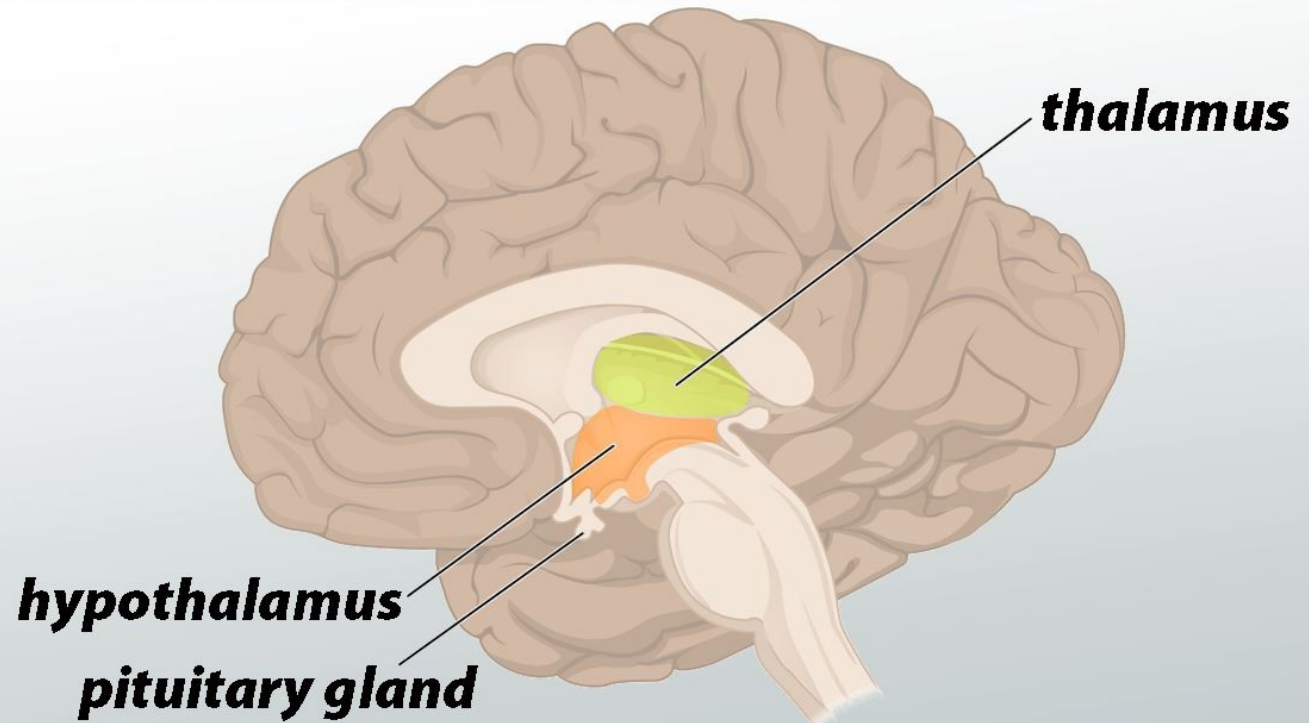


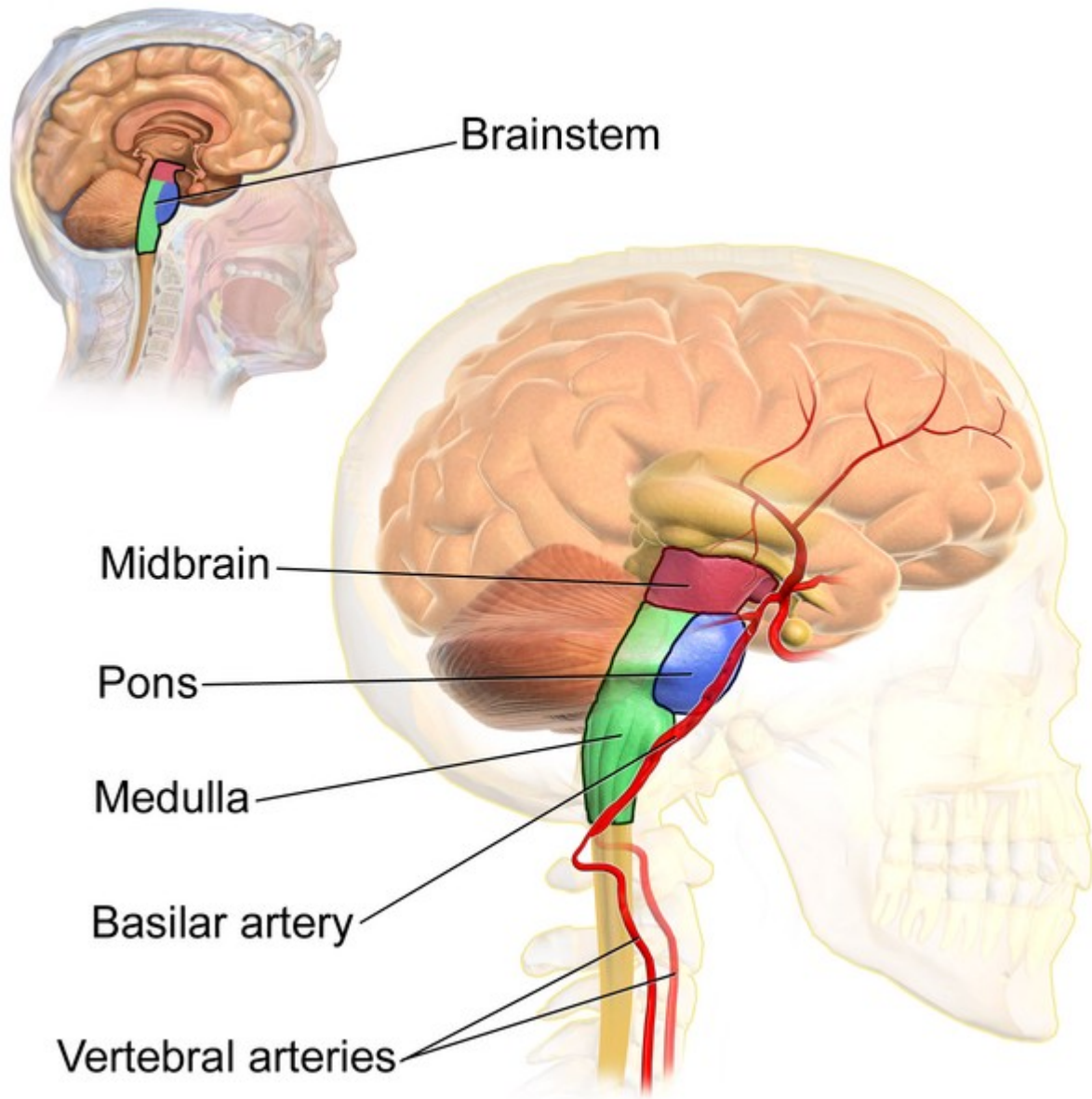


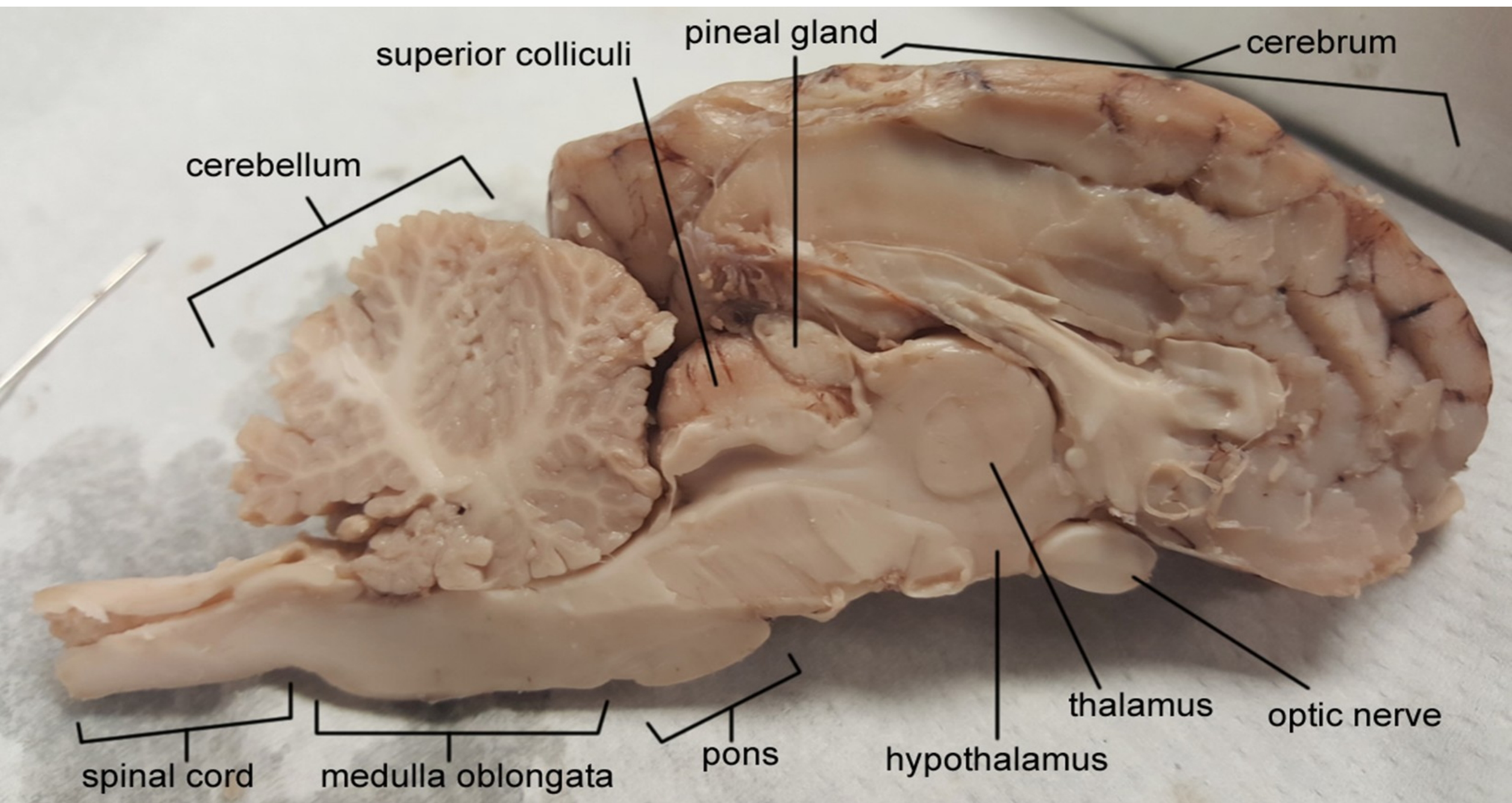
Diencephalon



IMPORTANCE OF THE DIENCEPHALON







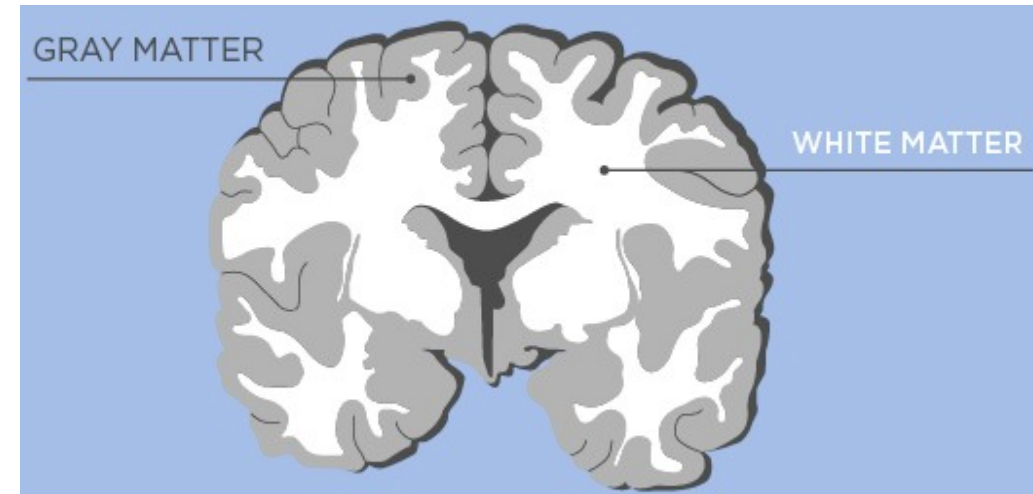
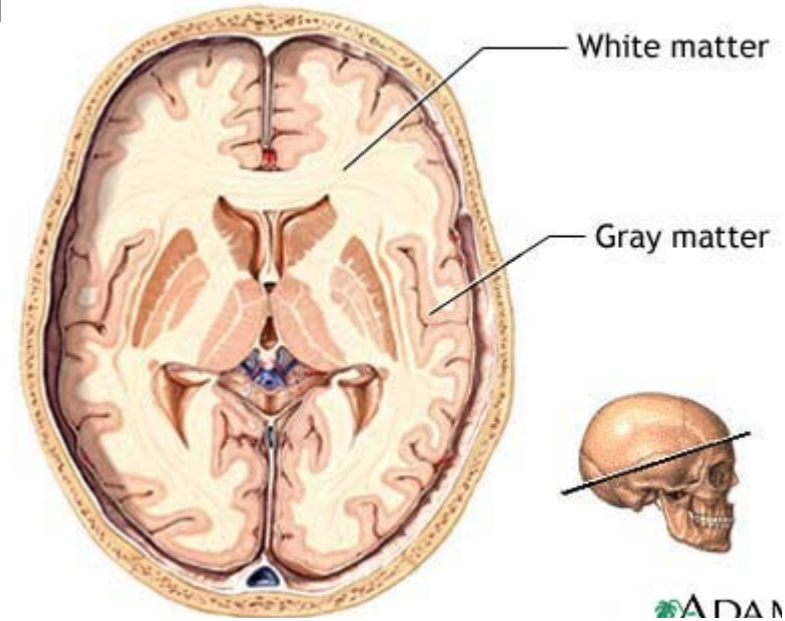
Physiology of Central Nervous System

Cerebrum

- Cerebrum is the largest part of brain.

Cerebral cortex:

- The surface of cerebrum is called as cortex.
- Cerebral cortex contains billions of nerve cell bodies, Cerebral cortex is made of gray matter.
- Gray matter is non myelinated nervous tissue.
- White matter of cerebrum is situated below the cerebral cortex.
- Cerebrum is divided into two equal



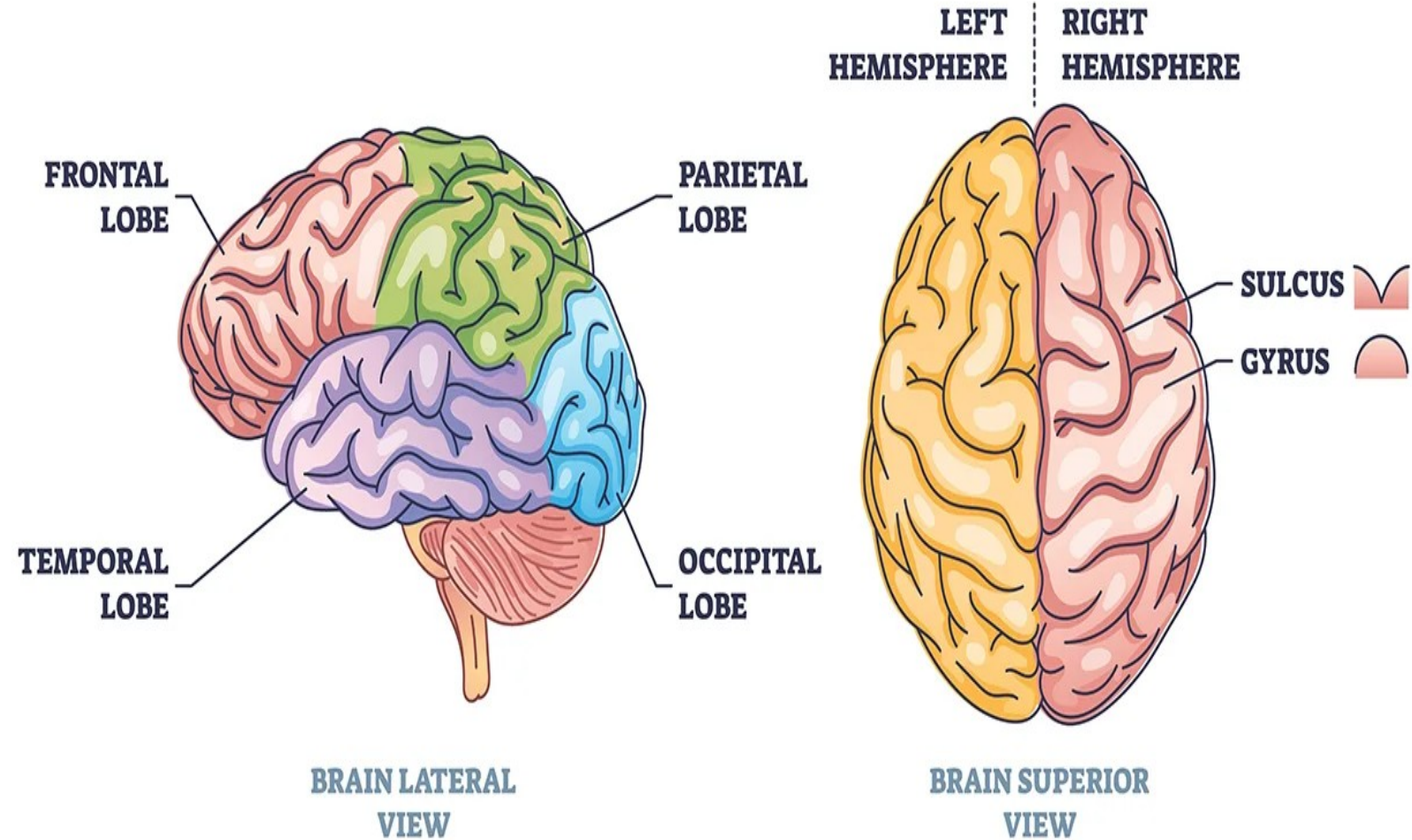
Cerebrum

Lobes of Cerebrum

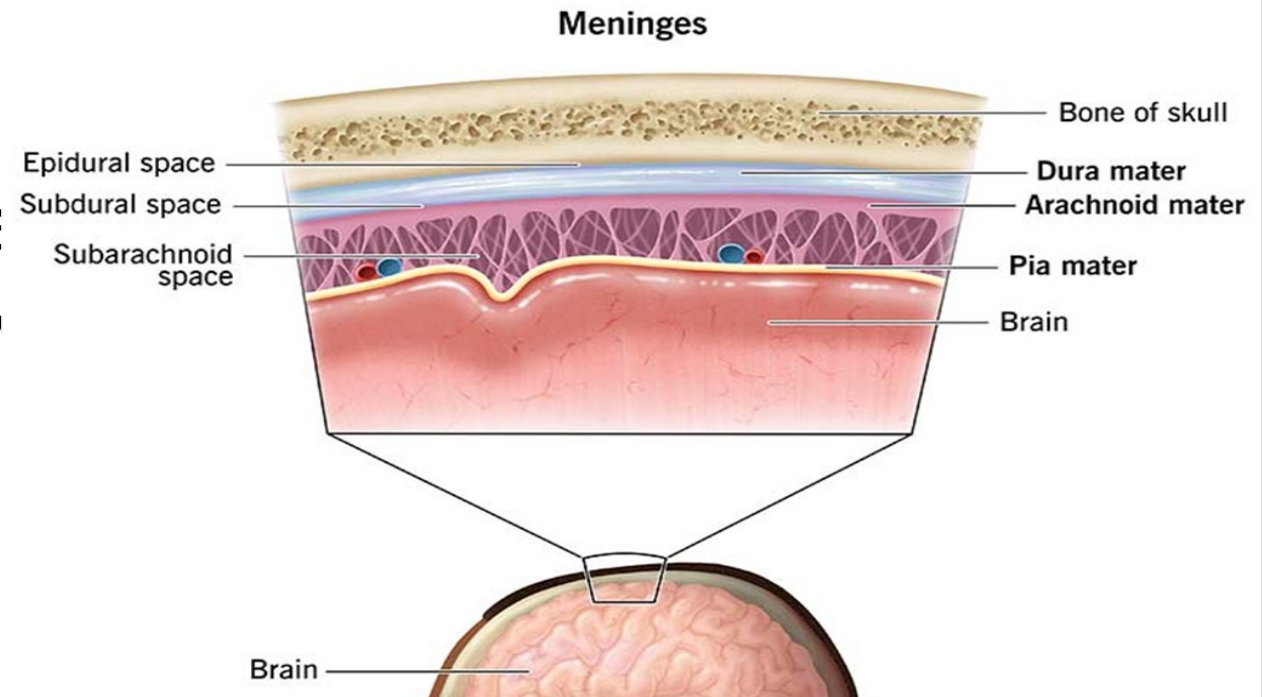
- Each cerebral hemisphere is subdivided into four lobes.

Four cerebral lobes

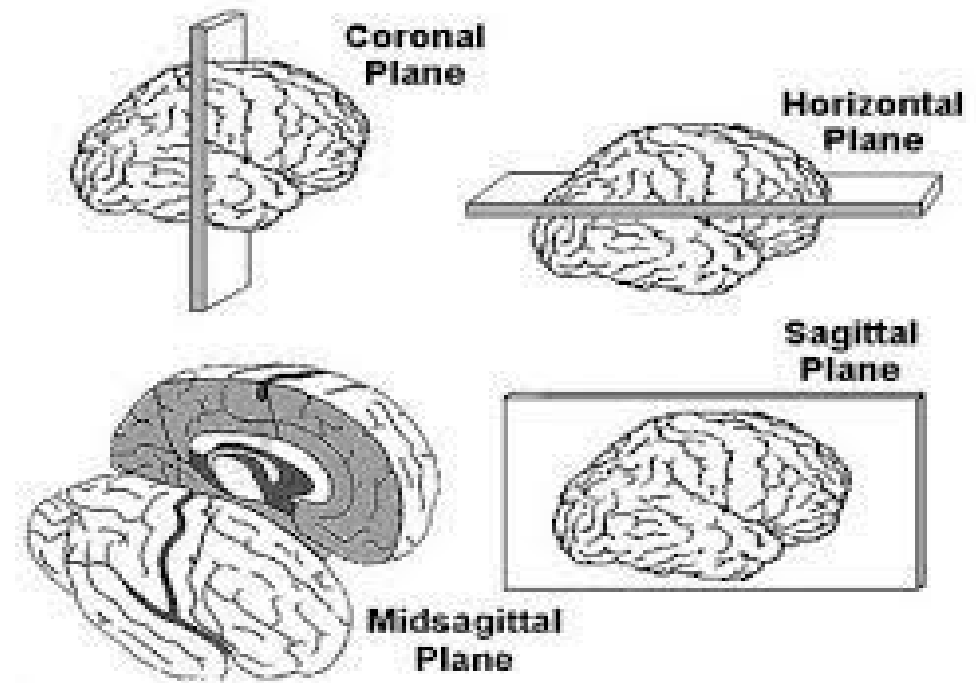
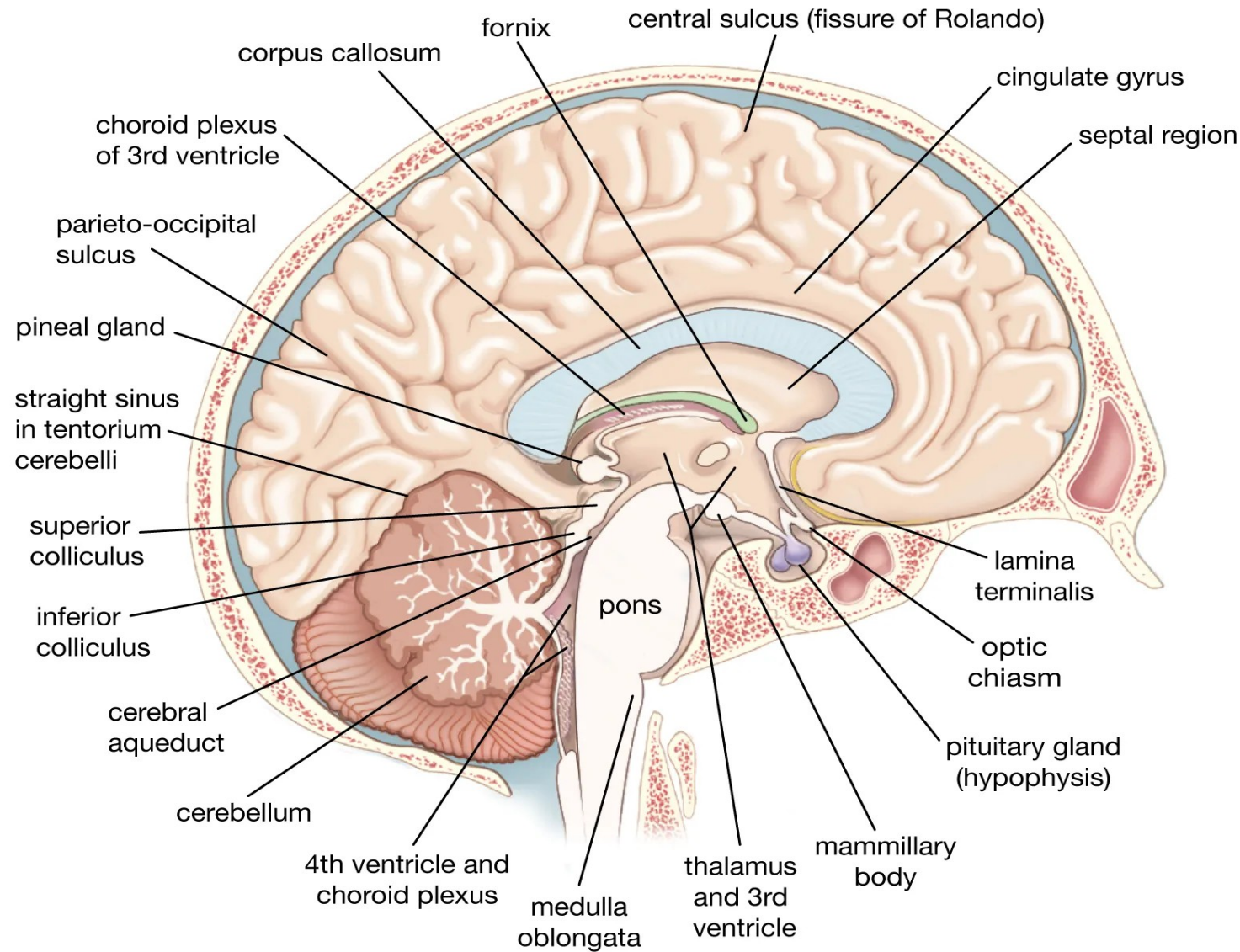
1. Frontal lobe
2. Parietal lobe
3. Temporal lobe
4. Occipital lobe



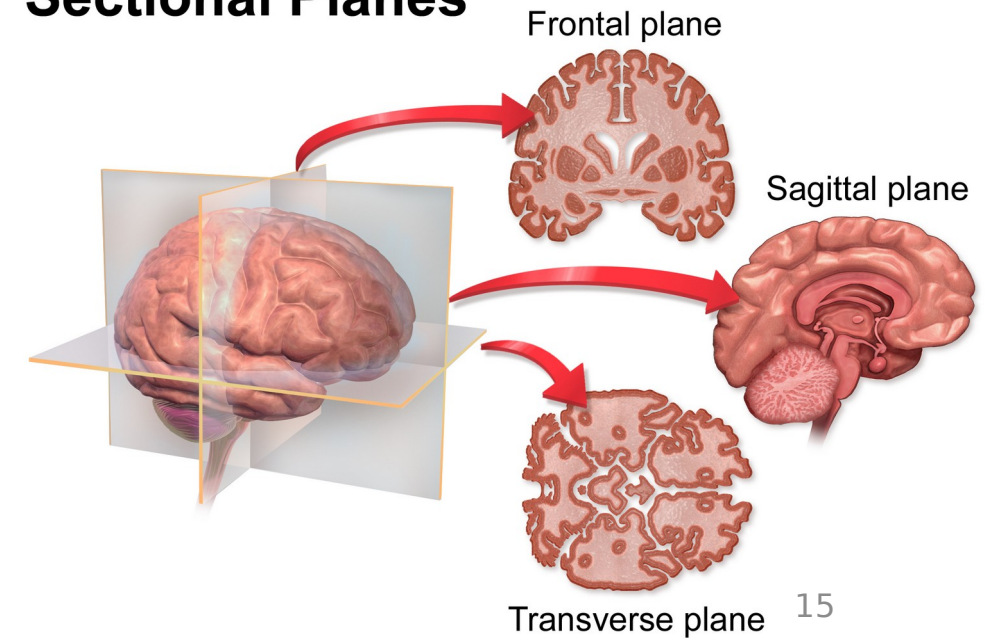
- Both hemispheres are connected with transverse bundle of fibers called as **corpus callosum**.
- **Protection of brain** : Cranial bones, meninges and cerebrospinal fluid protect the brain.
- **Coverings of brain**: Brain is covered with cranial meninges. Cranial meninges are continuous with spinal meninges.
- The cranial meninges are –
 - 1. Dura mater - Outermost cover
 - 2. Arachnoid mater - Middle cover
 - 3. Pia mater - Innermost covering

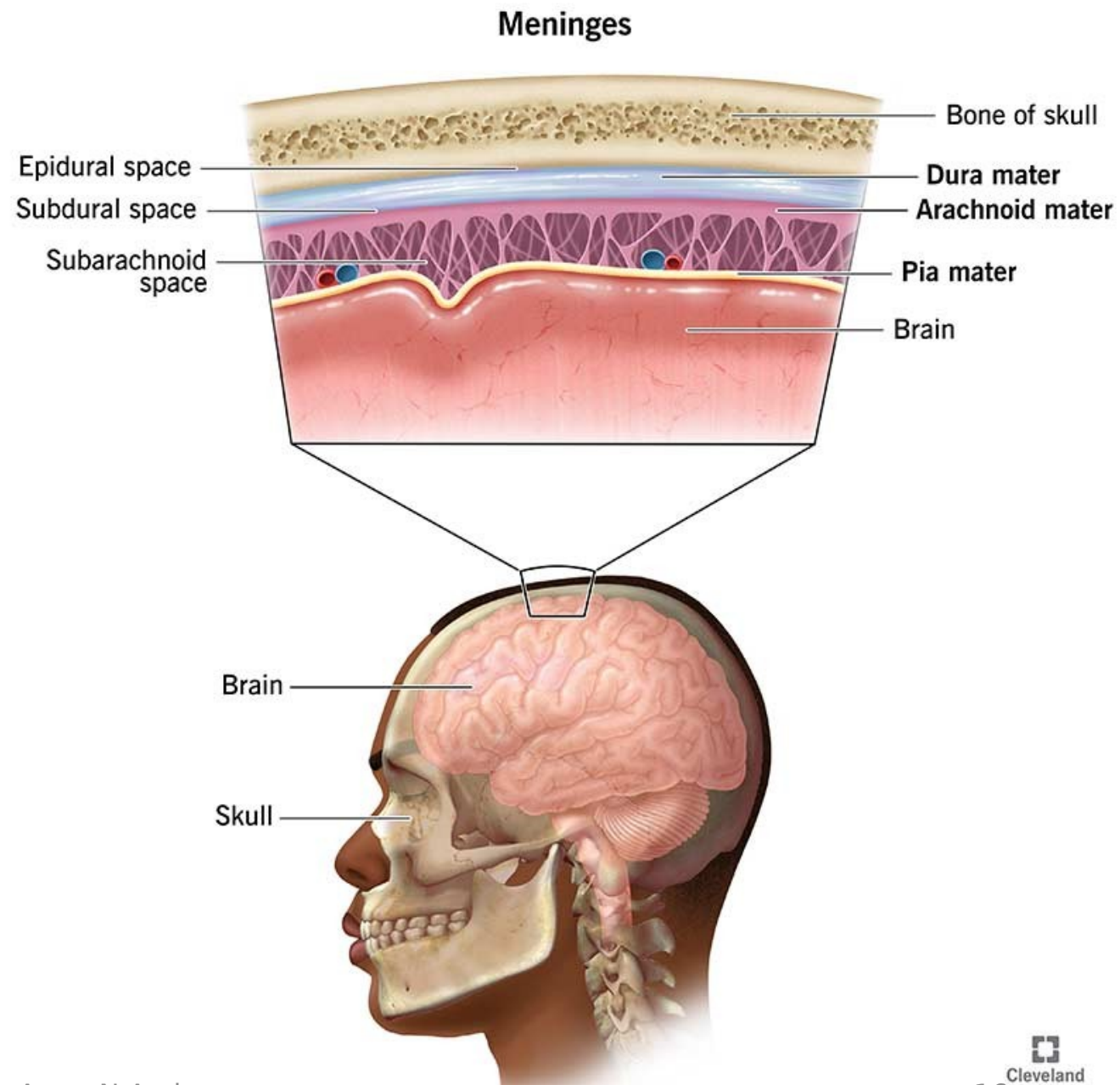
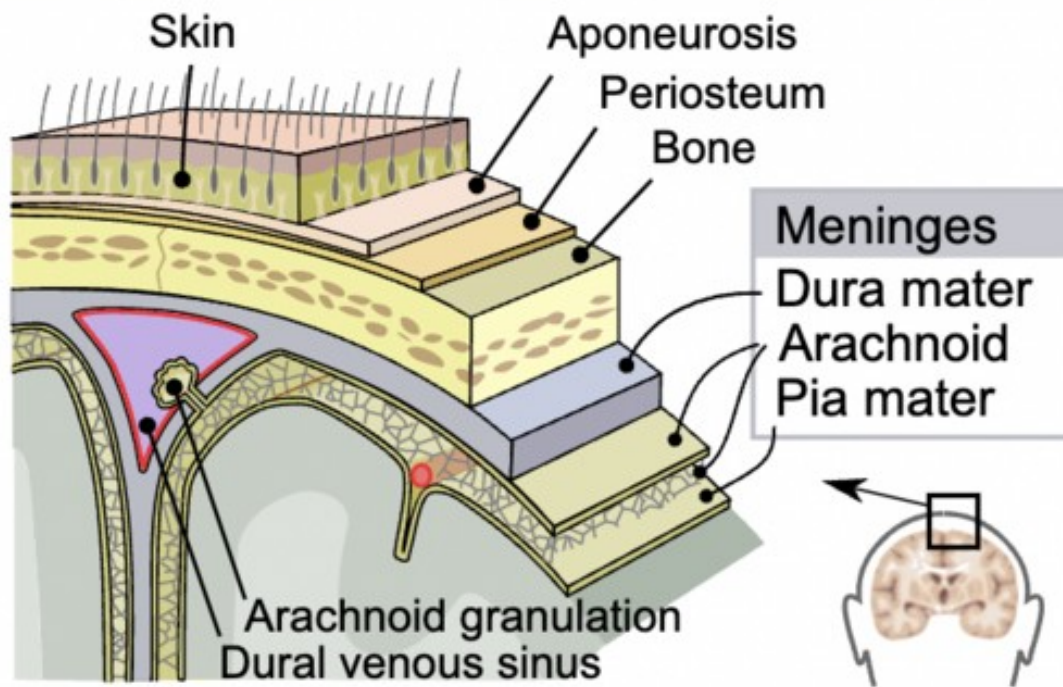


Human brain in cross section



Sectional Planes



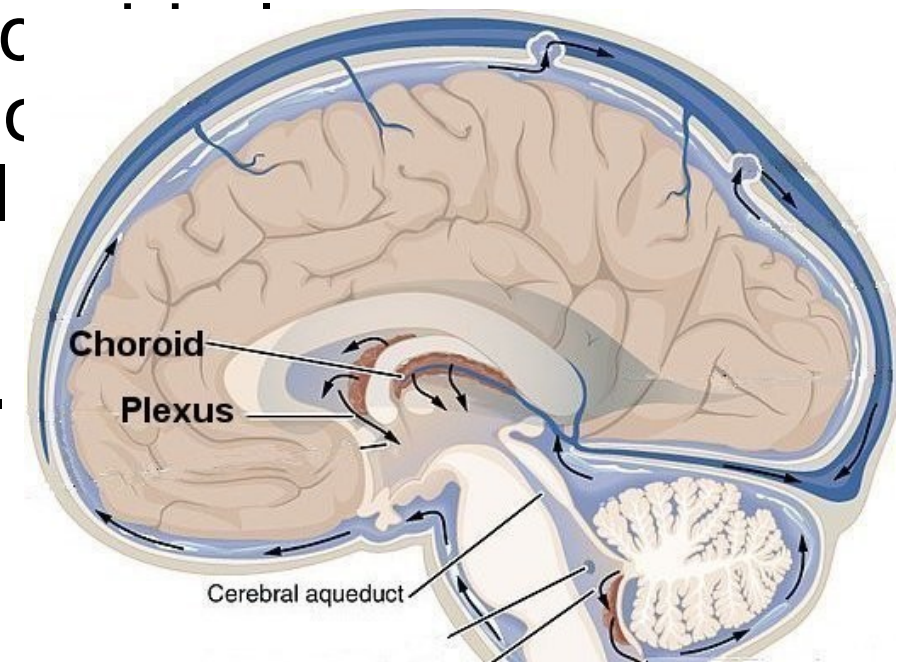


Cerebrospinal Fluid (C.S.F.)

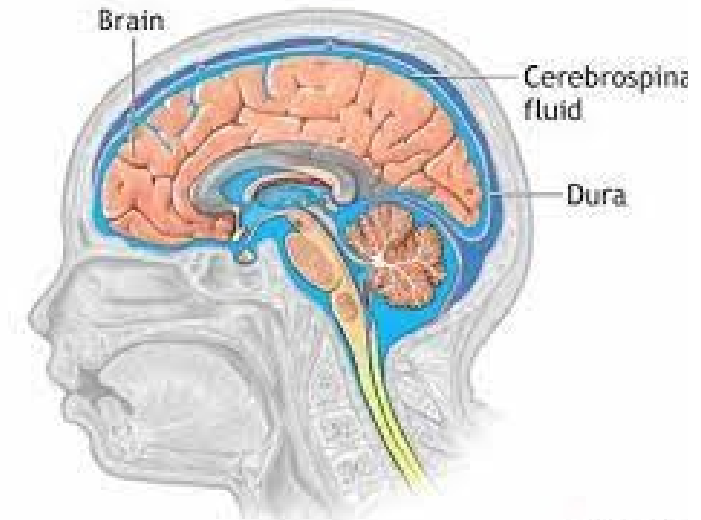
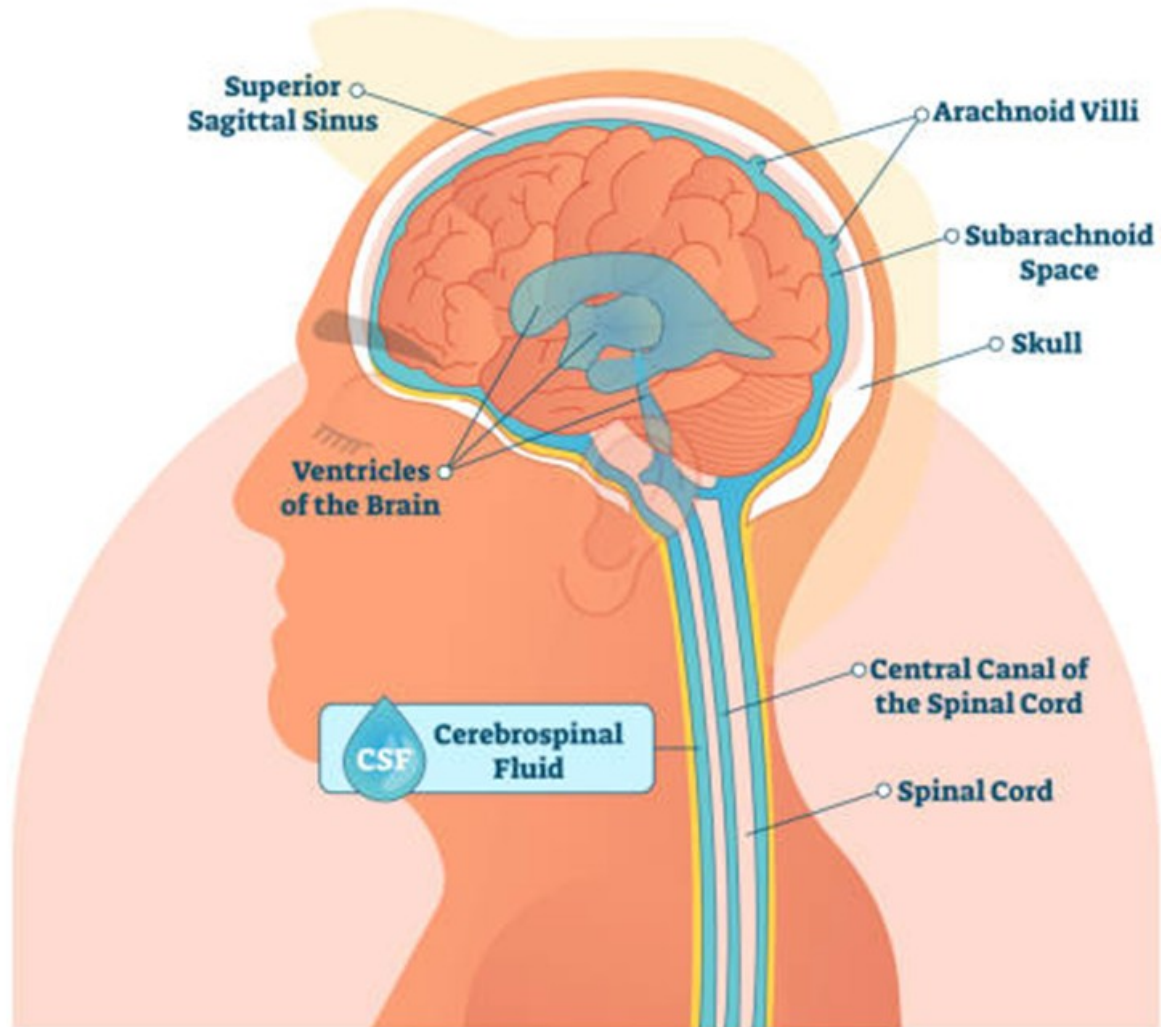
- Cranial bones and meninges protect brain and cerebrospinal fluid.
- Cerebrospinal fluid is a clear colourless fluid and it consists of proteins, glucose, urea, salts and some lymphocytes.
- Cerebrospinal fluid is formed in the choroid plexus and it is circulated through the subarachnoid spaces of brain and through central spinal cord.
- Normal volume of CSF is 80 to 150 ml.

Functions of Cerebrospinal Fluid

- Brain actually floats in CSF.
- CSF protects brain and spinal cord from trauma.



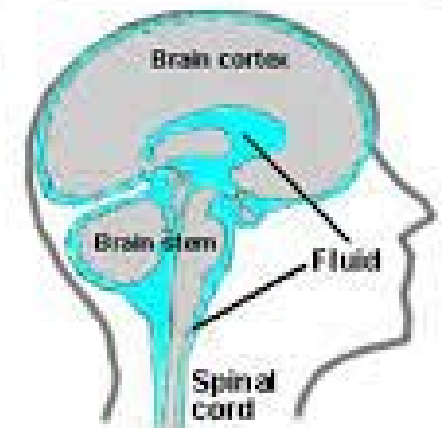
CEREBROSPINAL FLUID



Brain and Meninges

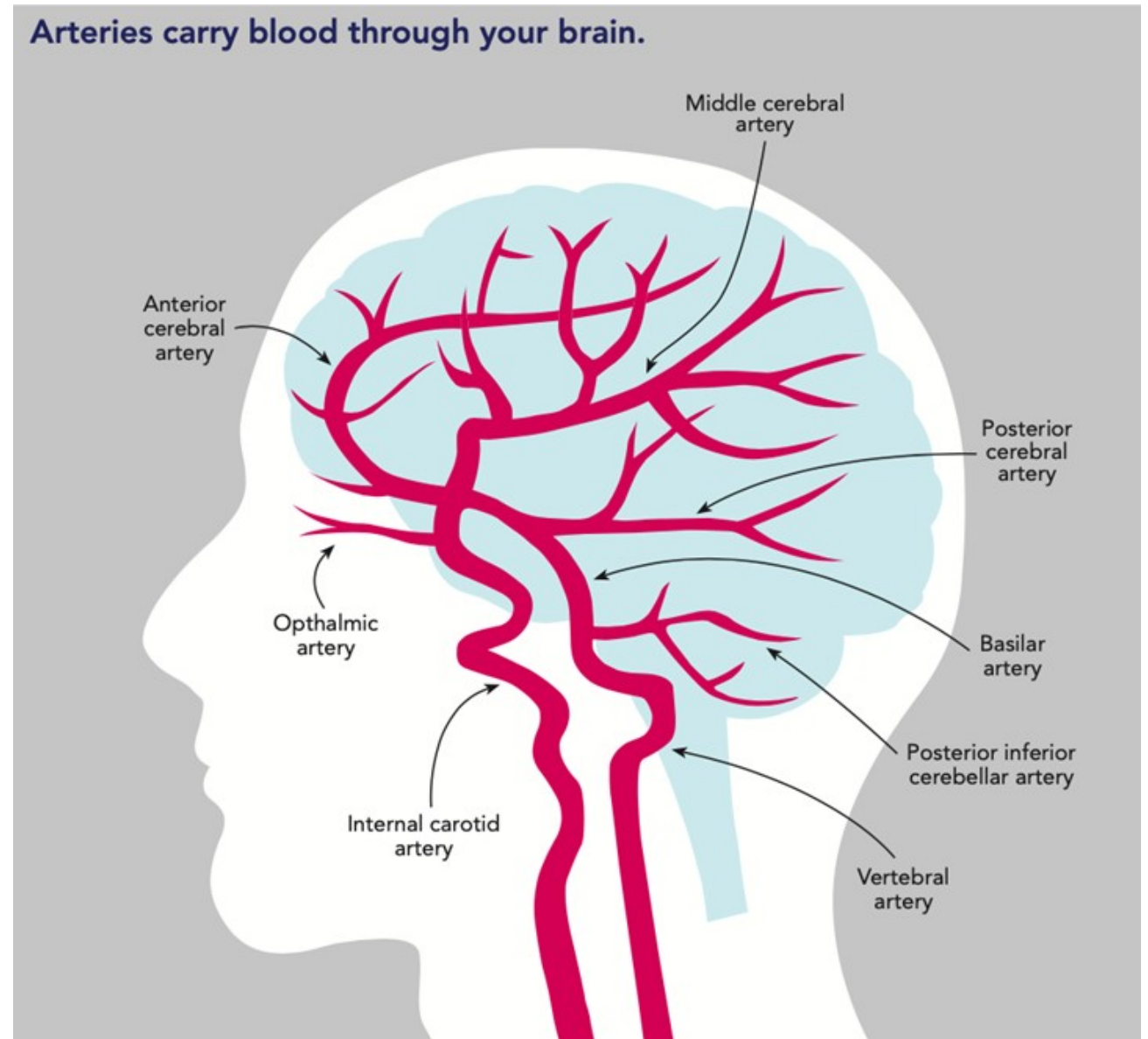


Cerebrospinal Fluid



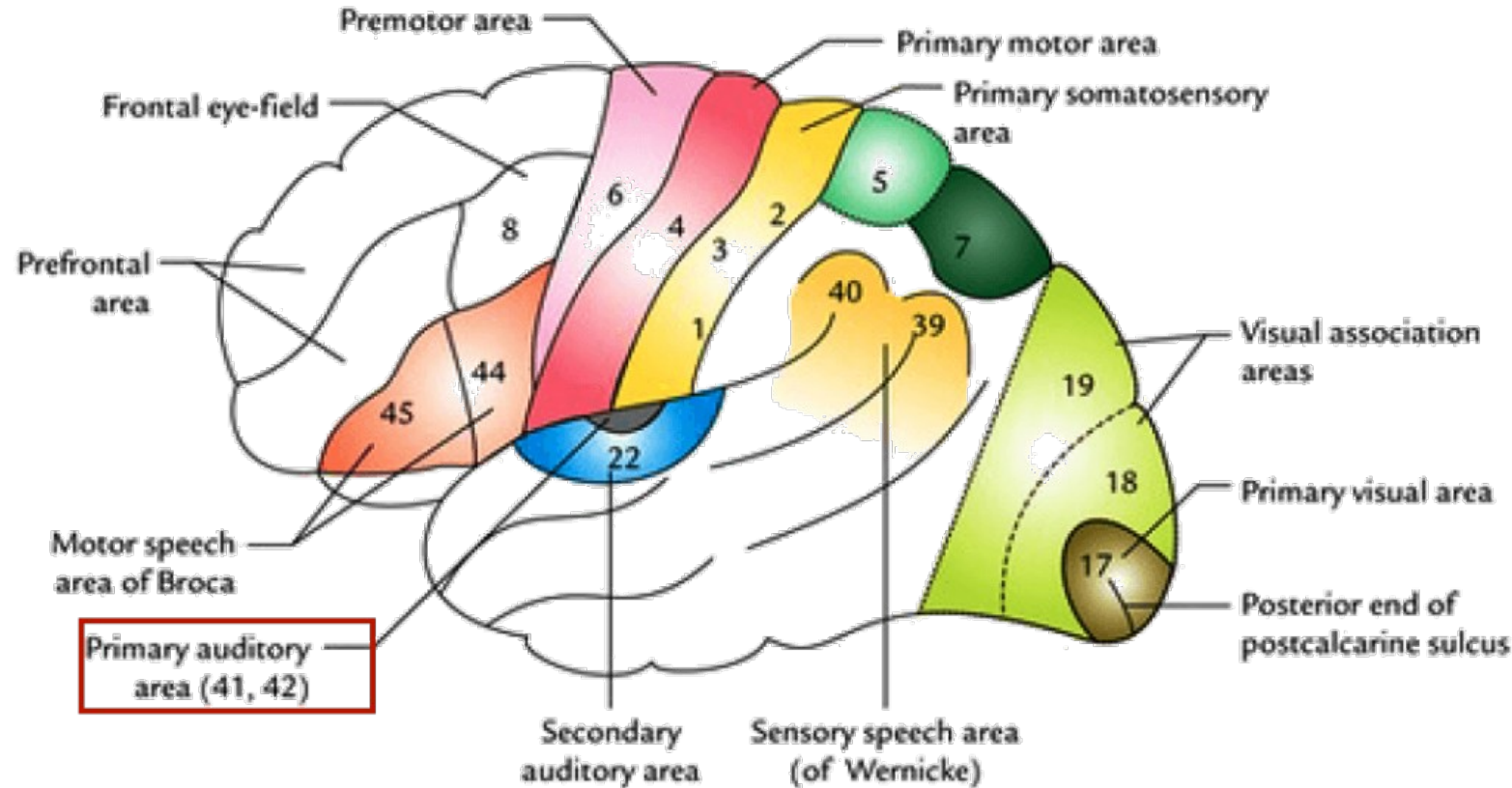
Blood Supply of Brain

- Brain has a large demand of oxygen and glucose.
- Cerebral arteries supply brain.
- Lack of oxygen for more than six seconds can lead to damage of brain cells.



Functional Areas of Cerebral Cortex

- Functionally cerebral cortex is divided into
 - (1)sensory areas
 - (2)motor areas
 - (3)Association areas
- Functional areas are located in various cerebral lobes.
- Functional areas are designated by particular numbers.



Motor areas

Primary motor area

Premotor cortex

Frontal eye field

Broca's area
(outlined by dashes)

Prefrontal cortex

Working memory for spatial tasks

Executive area for task management

Working memory for object-recall tasks

Solving complex, multitask problems

Central sulcus

Sensory areas and related association areas

Primary somatosensory cortex

Somatosensory association area

Somatic sensation

Gustatory cortex
(in insula)

Taste

Wernicke's area
(outlined by dashes)

Primary visual cortex

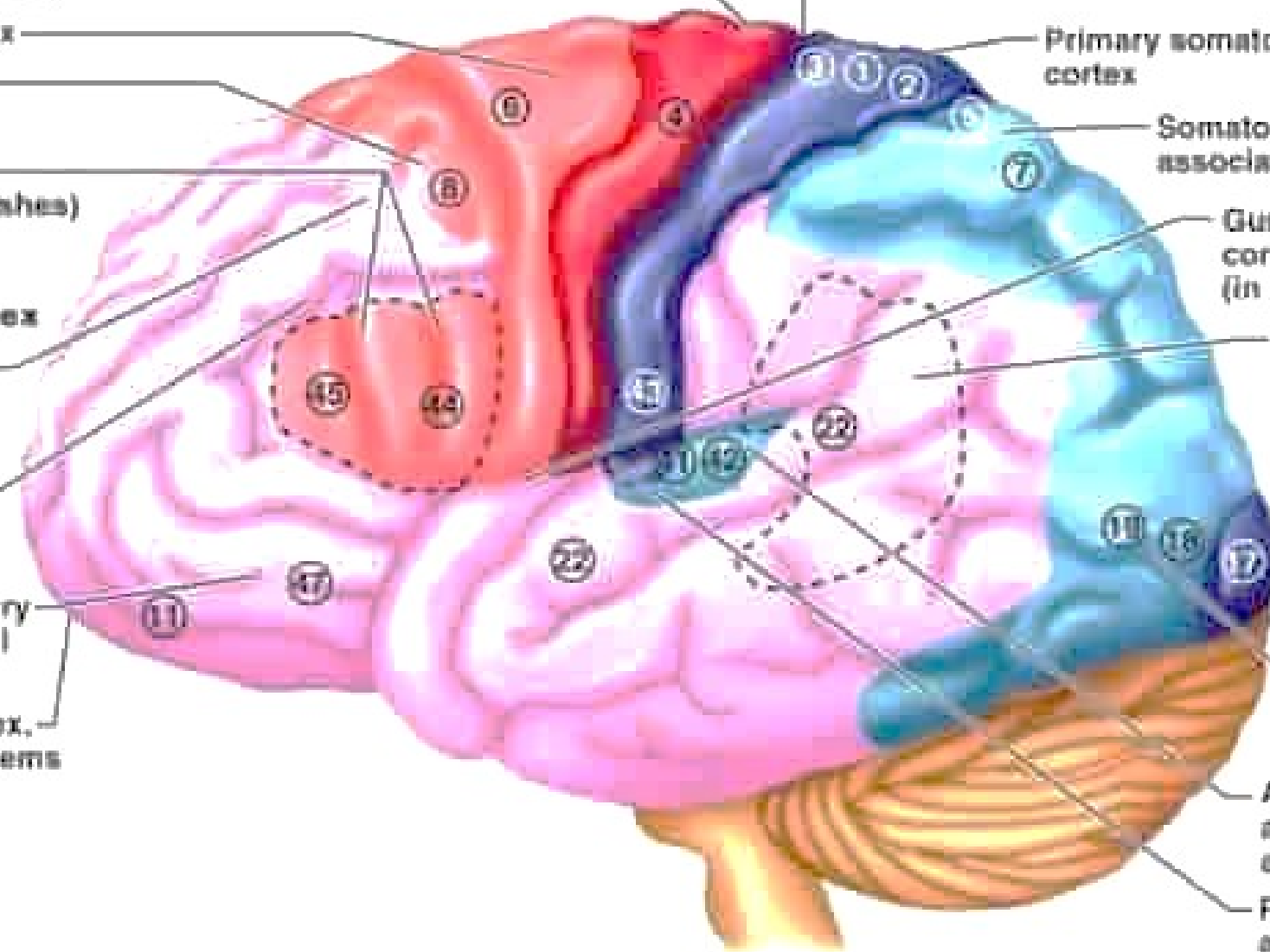
Visual association area

Vision

Auditory association area

Primary auditory cortex

Hearing



Sensory areas

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graph TD; SA[Sensory areas] --> P[Primary areas]; SA --> A[Association areas]; P --> GSA[General sensory area]; P --> PVA[Primary visual area]; P --> PAA[Primary auditory area]; P --> PGA[Primary gustatory area]; P --> POA[Primary olfactory area]; A --> ASA[Association sensory area]; A --> AVA[Association visual area]; A --> AAA[Association auditory area];
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Primary areas



General sensory area
Primary visual area
Primary auditory area
Primary gustatory area
Primary olfactory area

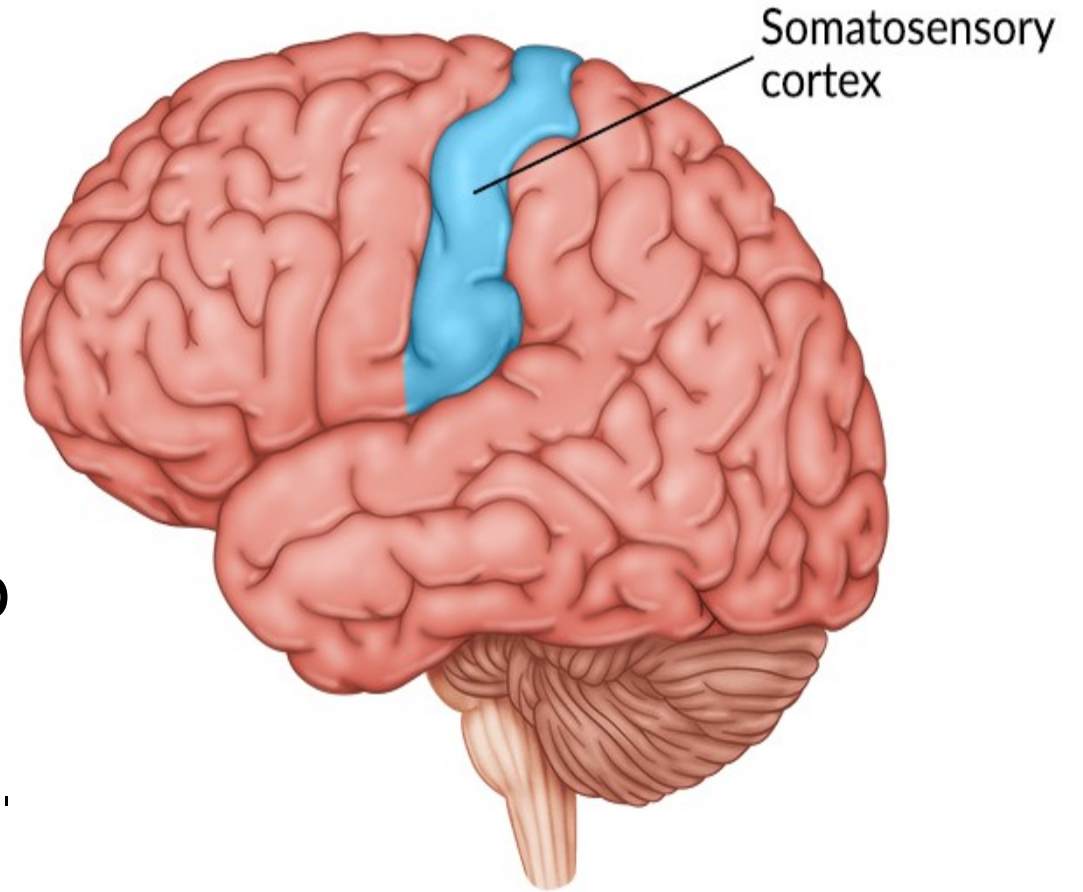
Association areas



Association sensory area
Association visual area
Association auditory area

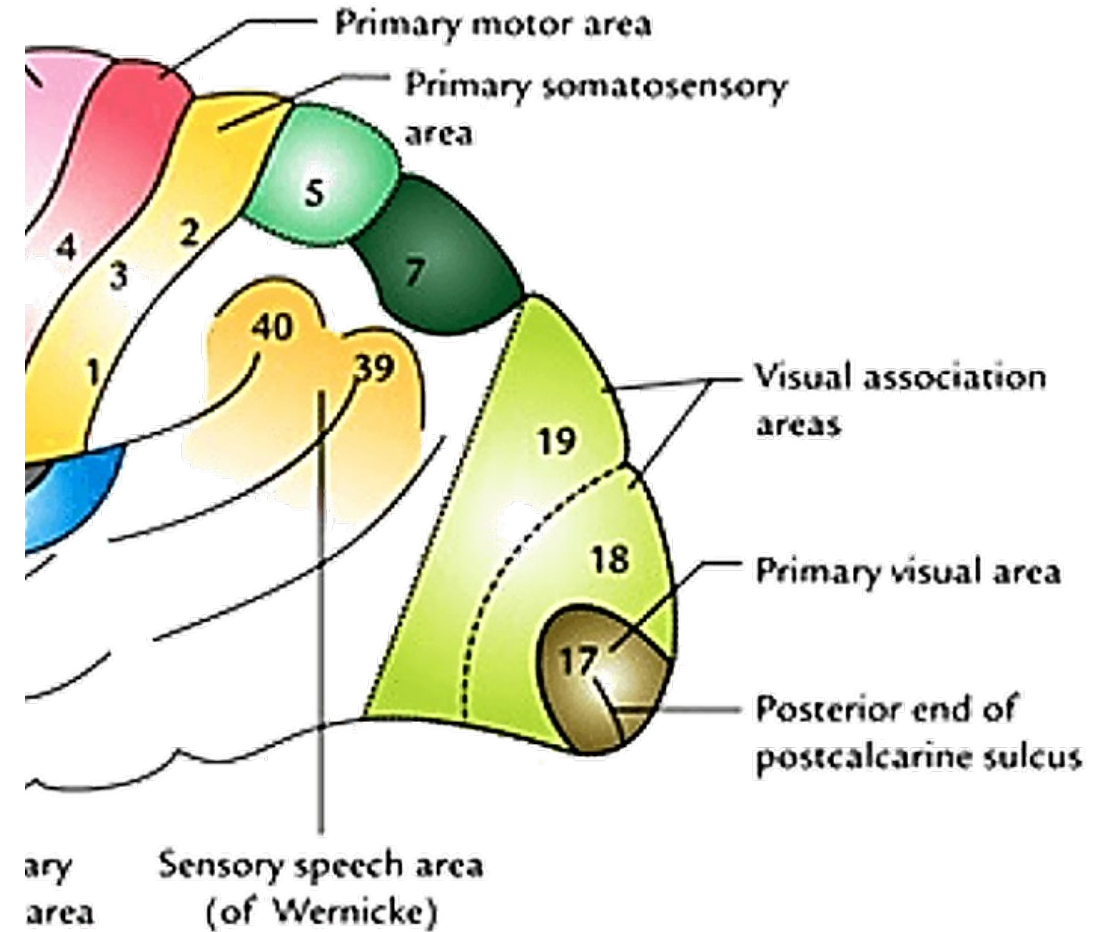
Function of General Sensory Area -

- Location - Parietal Lobe
- Area No. -1, 2, 3
- This area receives sensation from skin, muscles and various organs of the body.
- Whole body is mapped in this area.
- This area can identify the exact point of body from where the sensation is arising.



Functions of Association Sensory Areas

- Location - Parietal lobe
- Area No. -5,7
- Association sensory areas receives sensory information(inputs) from the thalamus.
- This area integrates and interprets the sensation.
- Association area can detect shape and texture of an object without looking at it.
- This information is stored as memory of past experience.

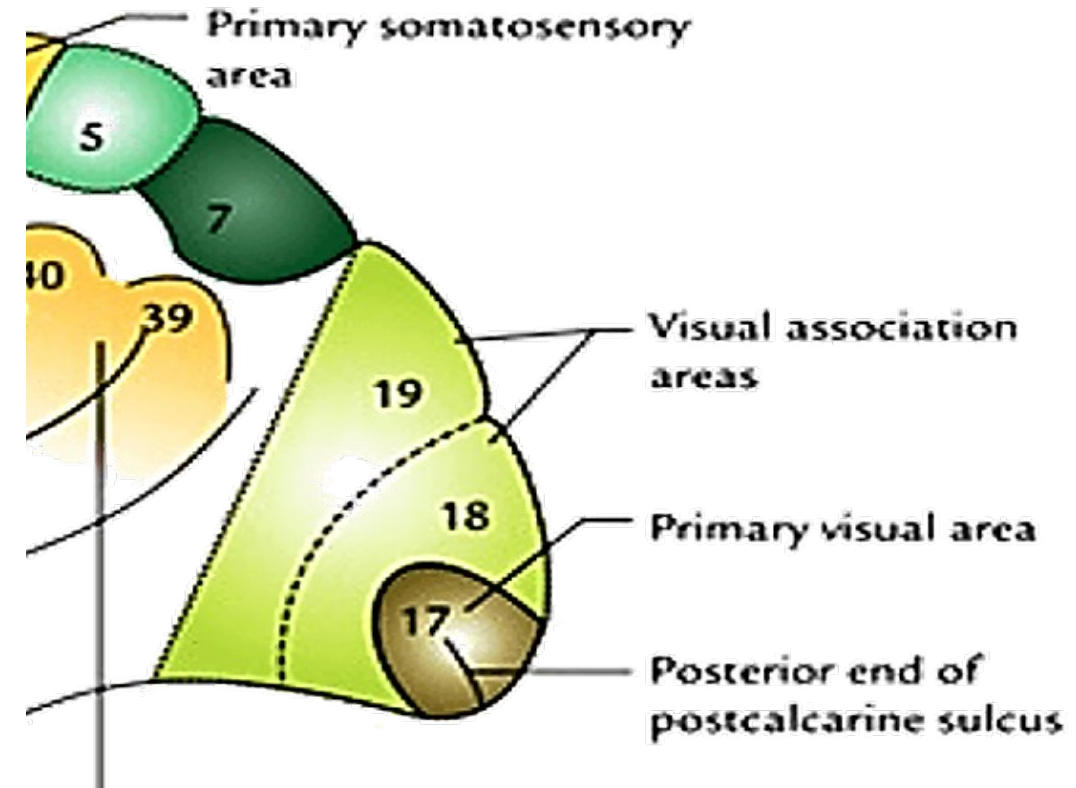


Functions of Primary Visual Area

- Location- Occipital lobe
- Area No. -17
- Interpretation of shape, color and movement of an object are the functions of primary visual area.

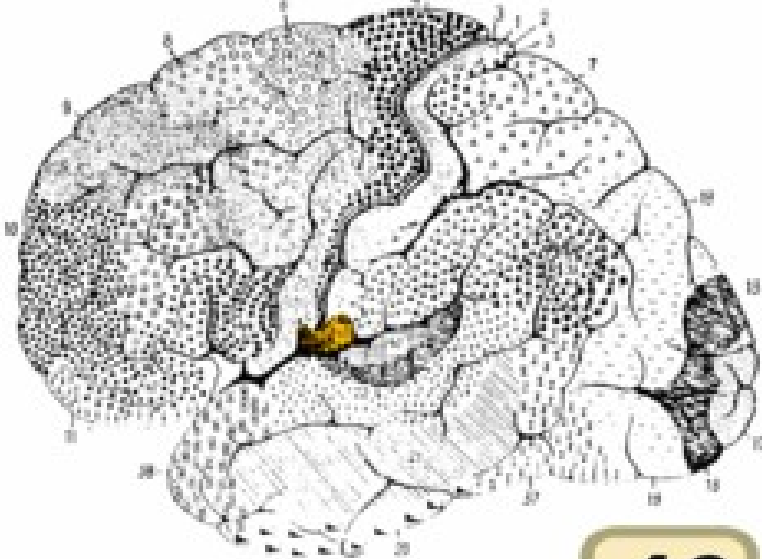
Functions of Visual Association Area

- Location-Occipital lobe
- Area no. 18, 19
- Functions of visual association area are (1) To store visual experiences. (2) To establish present visual experience with past one and to

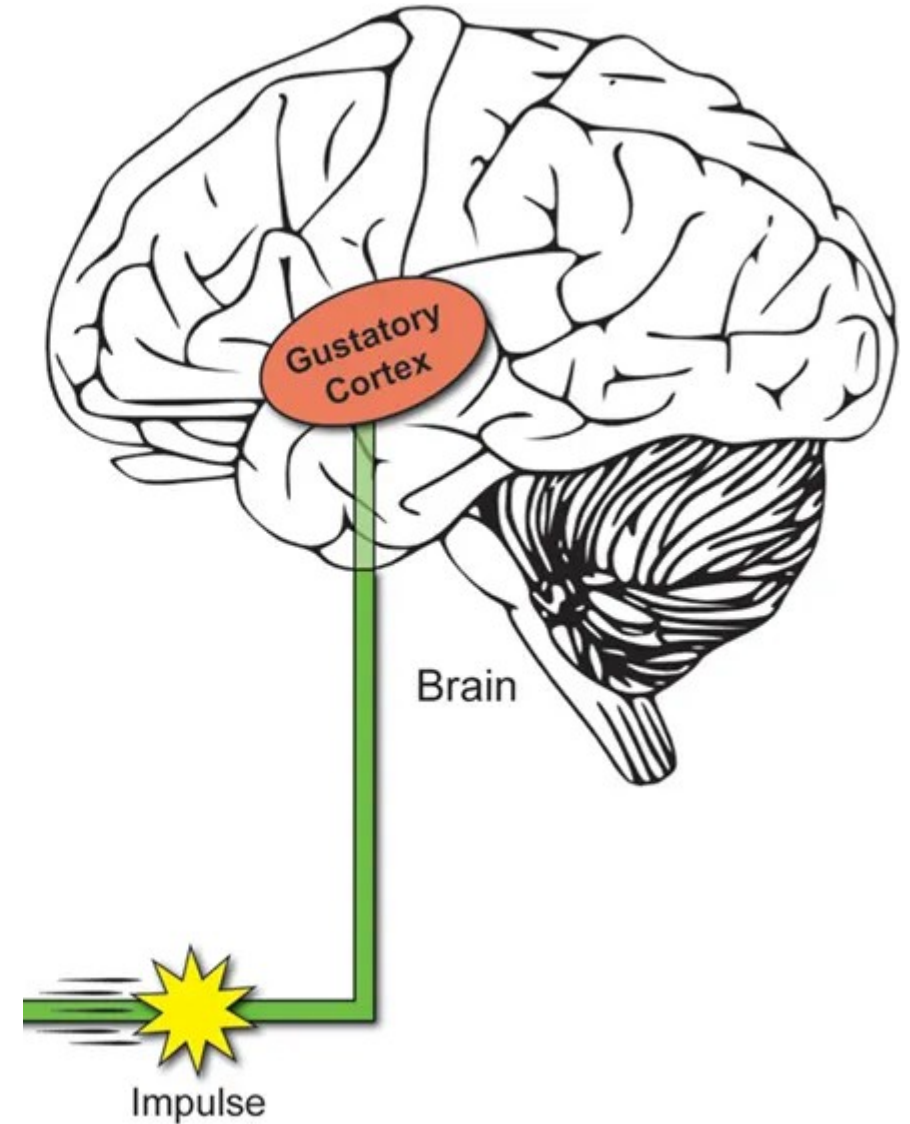


Functions of Primary Gustatory Area

- Location- Parietal lobe
- Area no. - 43
- Primary gustatory area receives sensations from taste buds.
- Its function is to interpret sensory information.



43

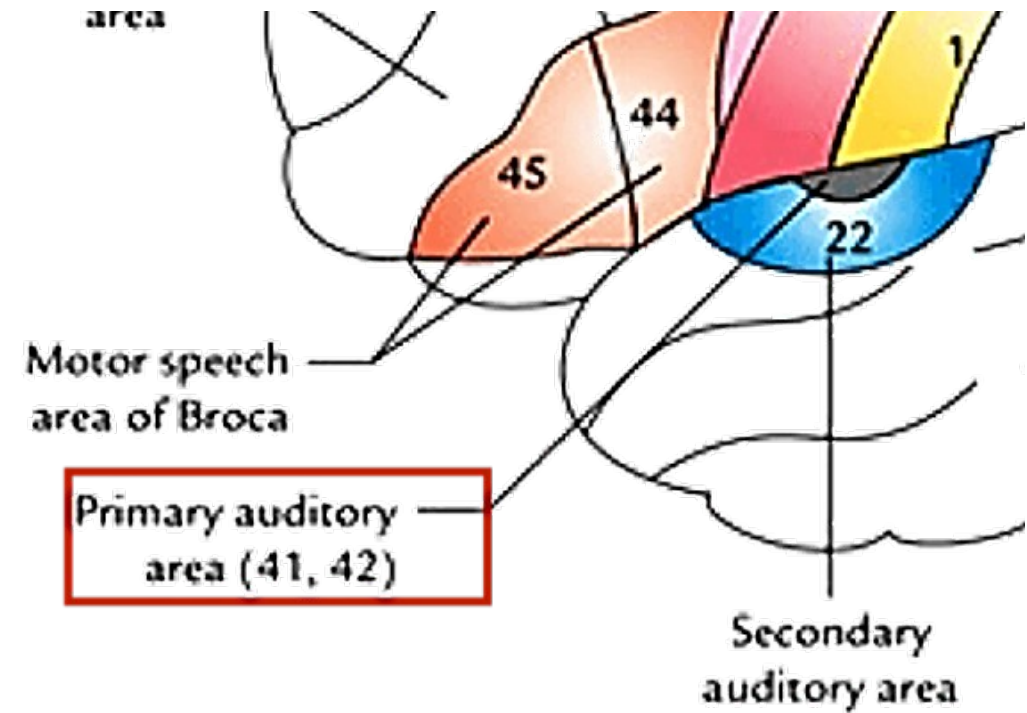


Functions of Primary Auditory Area

- Location- Temporal lobe
- Area no. 41, 42
- Primary auditory area receives sensations from ears. It interprets pitch and rhythm of sound.

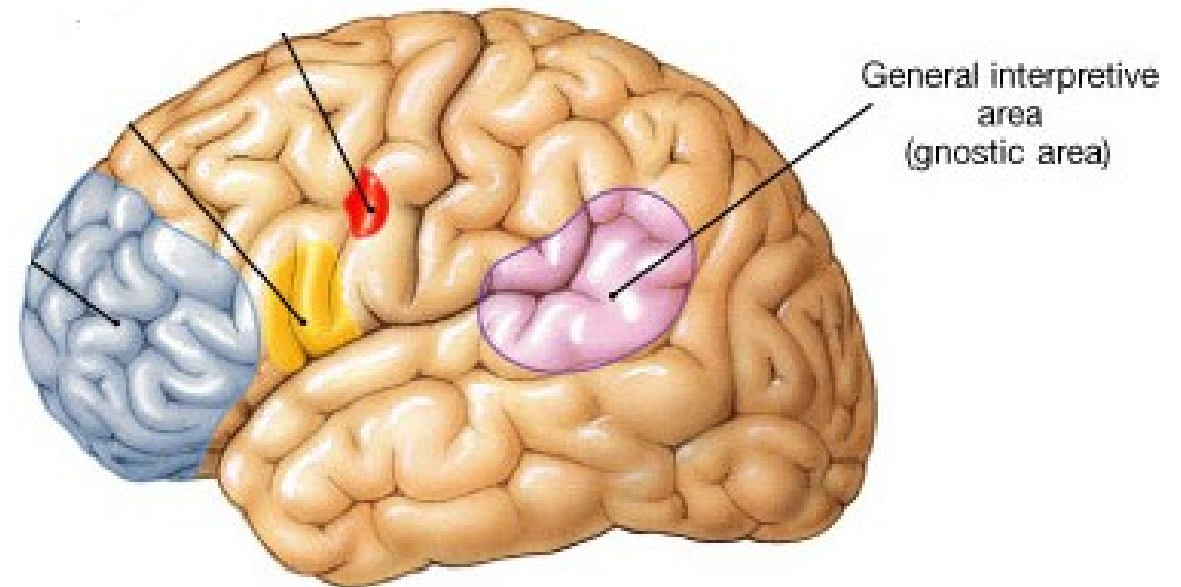
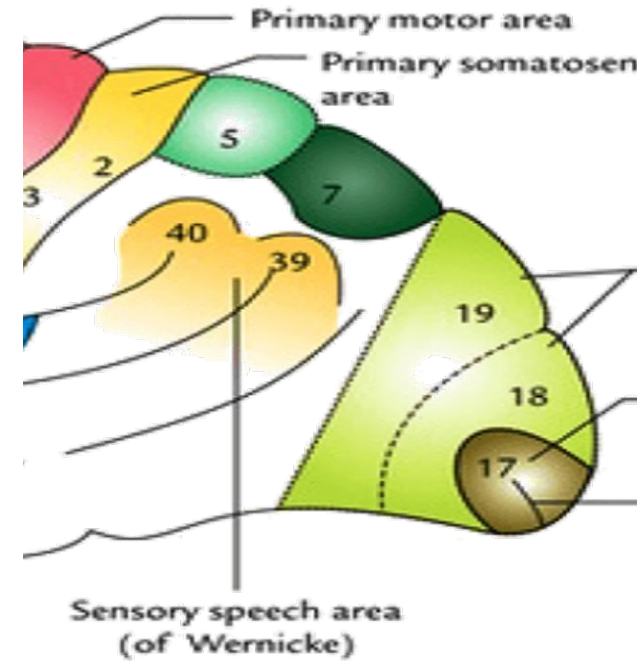
Functions of Auditory Association Area

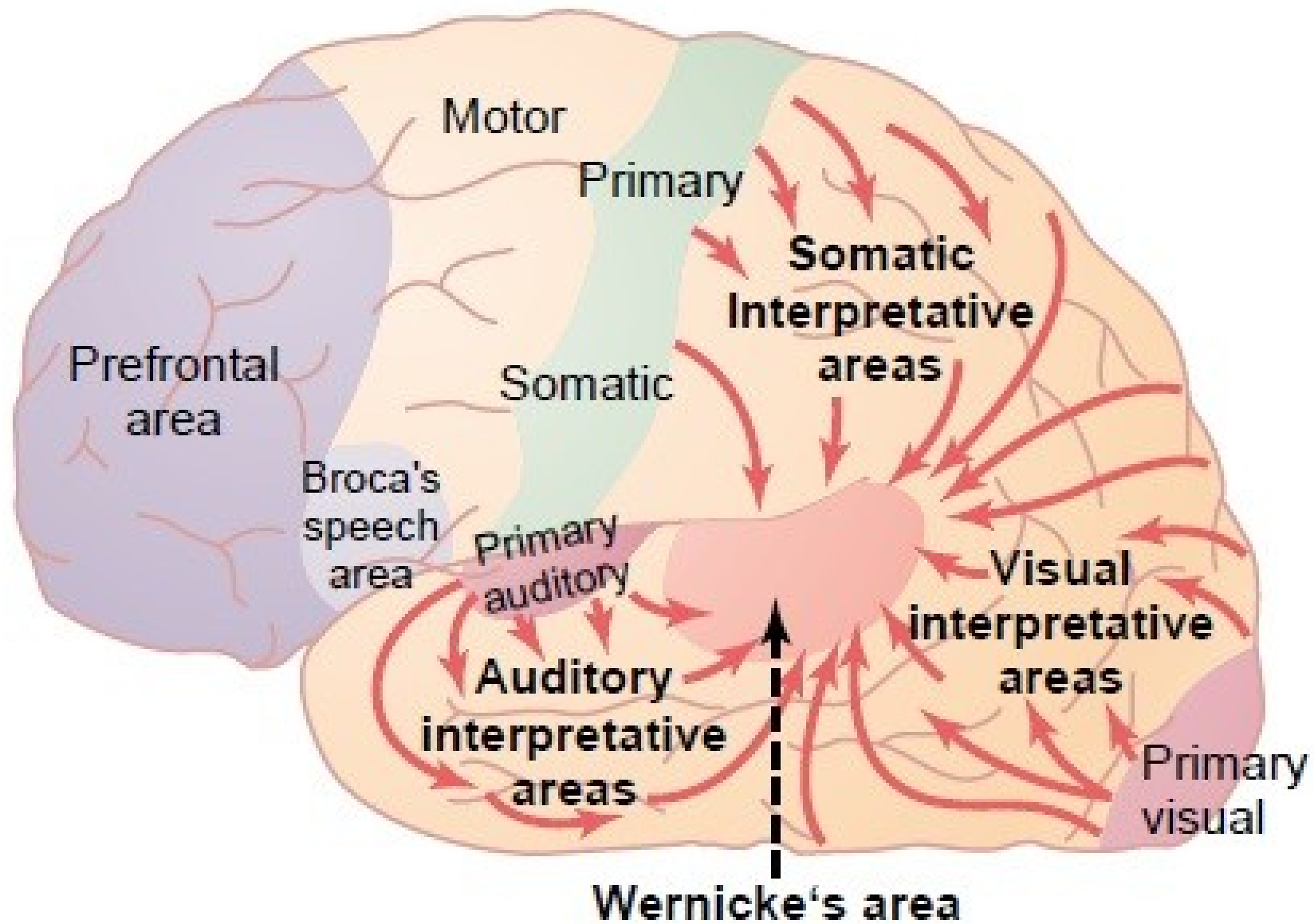
- Location -Temporal lobe
- Area no.-22
- Auditory association area can identify the nature of sound, whether sound is music, noise or speech. Auditory association area converts words into



Gnostic Area or Wernicke's Area

- Location- Area is located among visual association area, auditory association area and general association area.
- Area no. 5, 7, 39, 40
- **Gnostic area (Gnosis - Knowledge)** receives information from all association areas and from thalamus.
- It integrates interpretations from all parts of brain.
- It also receives sensory information from all sensory



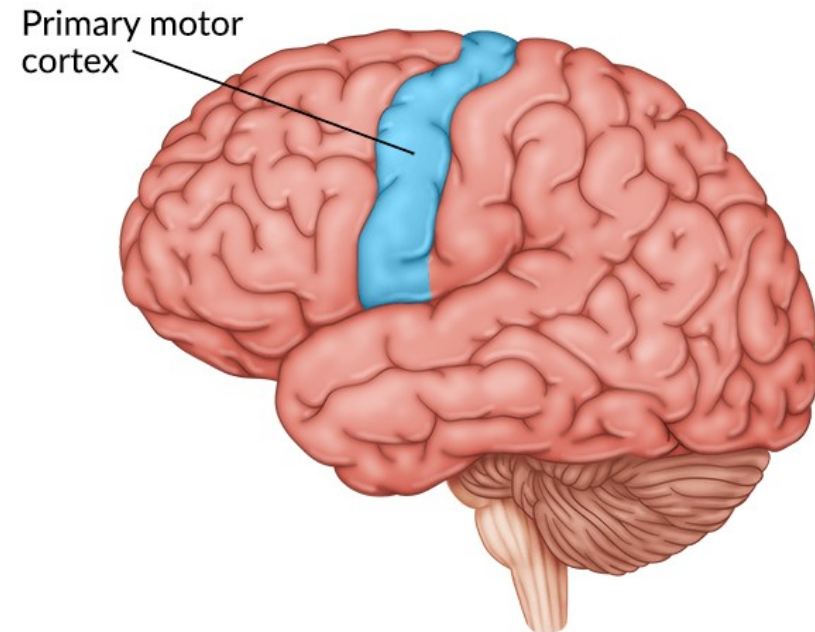
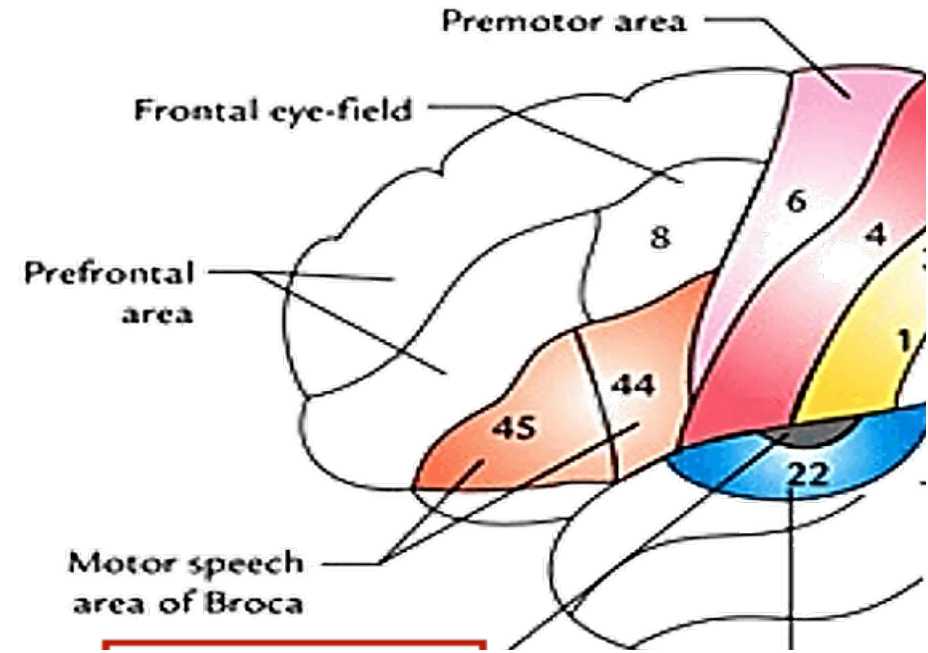


Functions of Motor Area of Cerebral Cortex

Motor area of cerebral cortex is located in frontal lobe.

motor areas of cerebral cortex

- Primary motor area (area 4)
- Premotor area (area 6)
- Frontal eye field area (area 8)
- Broca's area (area 44)

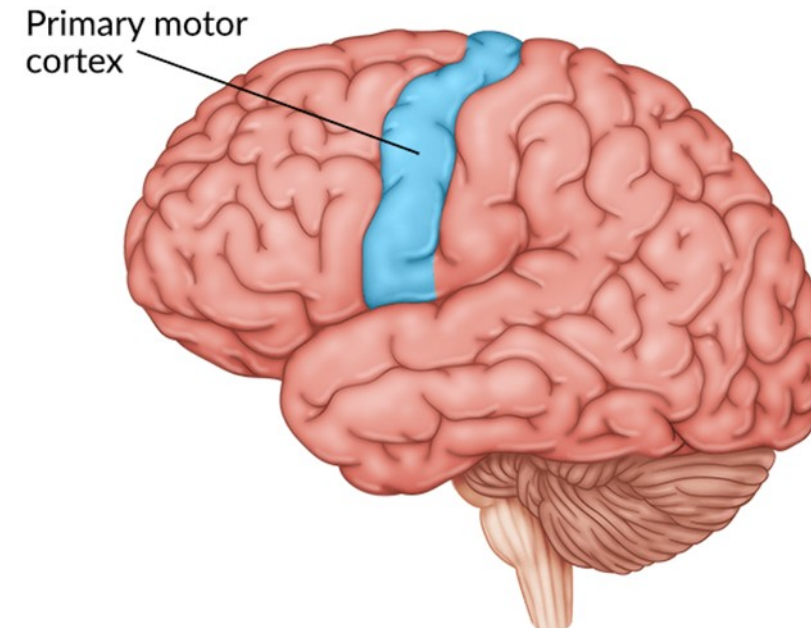
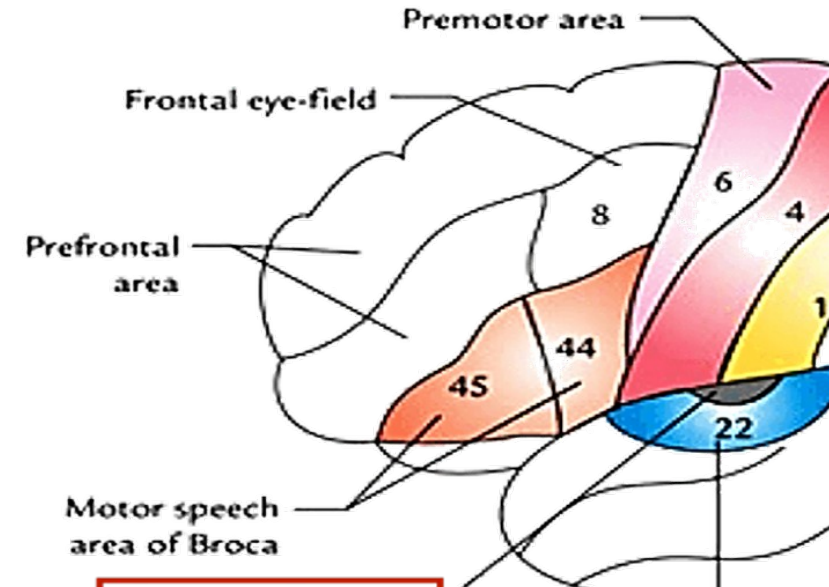


Functions of Premotor Area

- Premotor area coordinates muscle activity.

Functions of Primary Motor Area

- Primary motor area controls muscles of opposite side of the body, more than half of this area controls muscles of hands as well as speech.

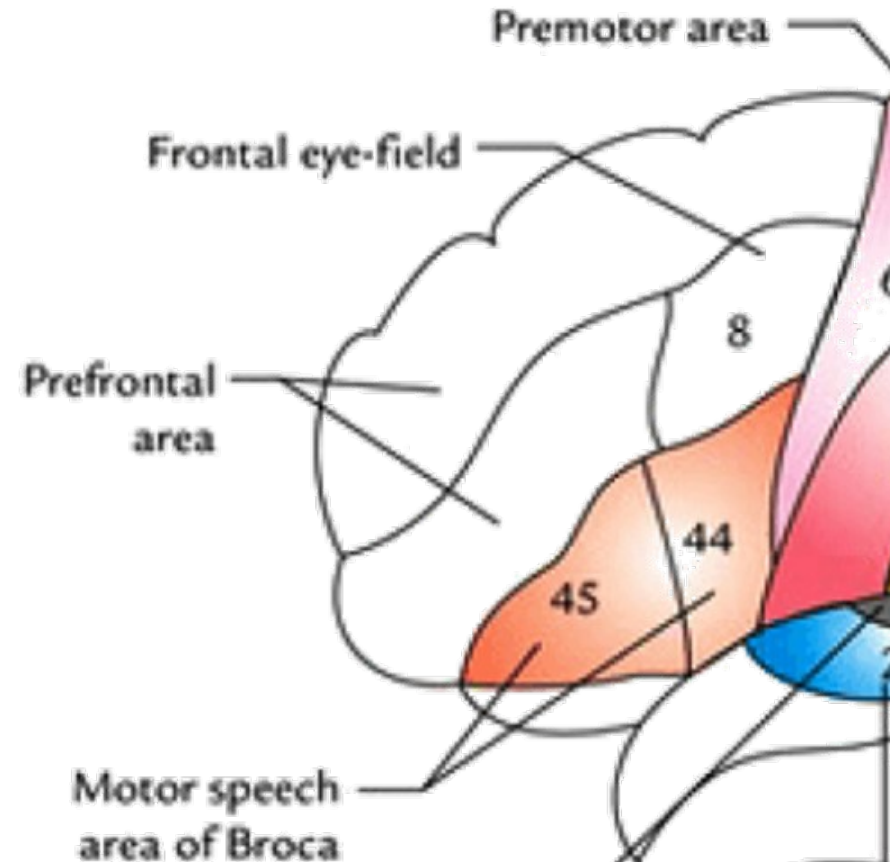


Functions of Frontal Eyefield Area

- Frontal eyefield area controls voluntary scanning movements of the eyes such as searching a word in a dictionary.

Functions of Broca's Area

- Broca's area converts thoughts into speech.
- Broca's area is located in the left frontal lobe.



Lobes and Concerned Sensations

Lobes	Sensations
Parietal lobe	Touch, pain, temperature, Taste
Temporal lobe	Smell, Sound
Occipital lobe	Vision

Functions of Sensory Areas of Cerebrum

Lobe	Areas	Functions
Parietal	General Sensory area	Receives sensation of touch, pain and pressure from body.
Parietal	Primary Gustatory area	Receives sensations of taste
Temporal	Primary Auditory area	Interpretation of pitch and rhythm of sound
Occipital	Primary visual area	Receives sensory impulses from eyes
Temporal	Primary olfactory area	Receives sensations of smell.

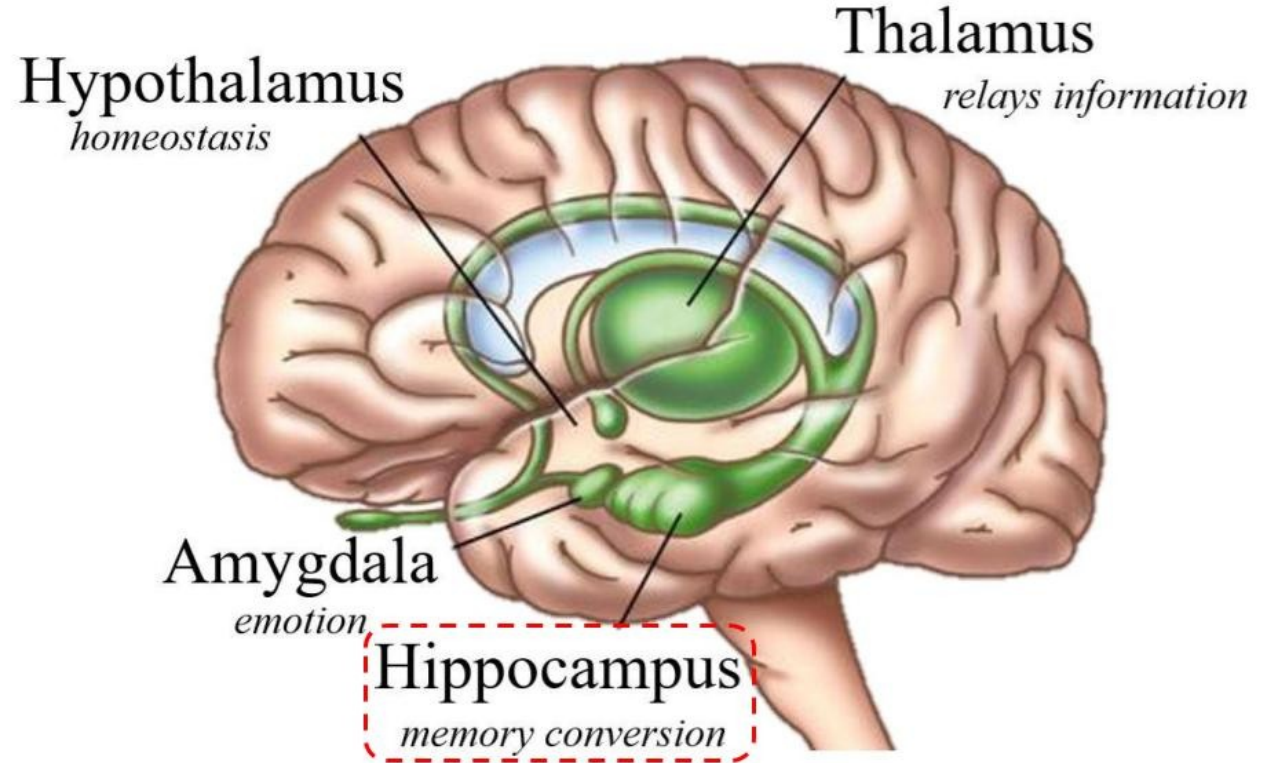
Limbic System or Emotional Brain

- Certain parts of cerebral hemisphere, thalamus and hypothalamus contributes limbic system.

Importance of Limbic System

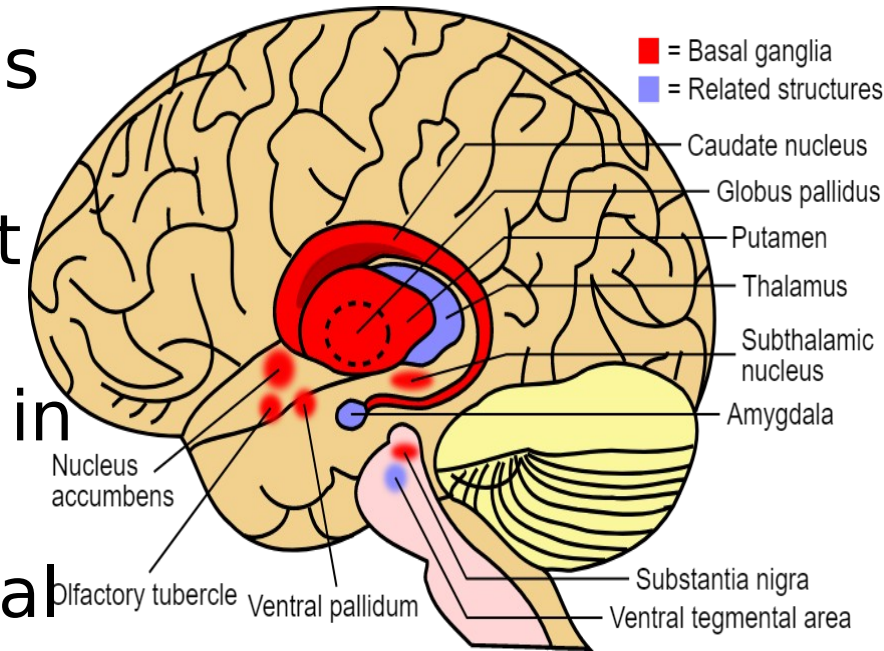
1. This system is concerned with memory and behavior pattern of a person.
2. Limbic system is concerned with emotions, love, anger, sexual feeling, anger etc.
3. Limbic system controls

The Limbic System



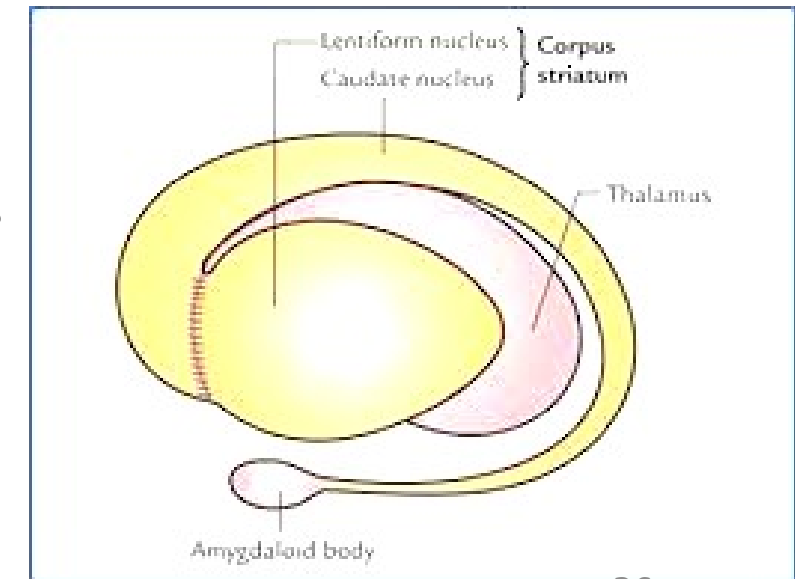
Basal Ganglia

- The paired masses of gray matter are called as basal ganglia.
- Basal ganglia are present in both right and left hemisphere of cerebrum.
- **Corpus striatum** is the largest basal ganglia in each hemisphere.
- Basal cell ganglia are connected to the cerebral cortex, hypothalamus and thalamus.



Functions of Basal Ganglia

- Basal ganglia control subconscious movements of skeletal muscles.
- Swinging movements of arms while walking is an example of subconscious movements.
- Damage to basal ganglia leads to abnormal body movements.

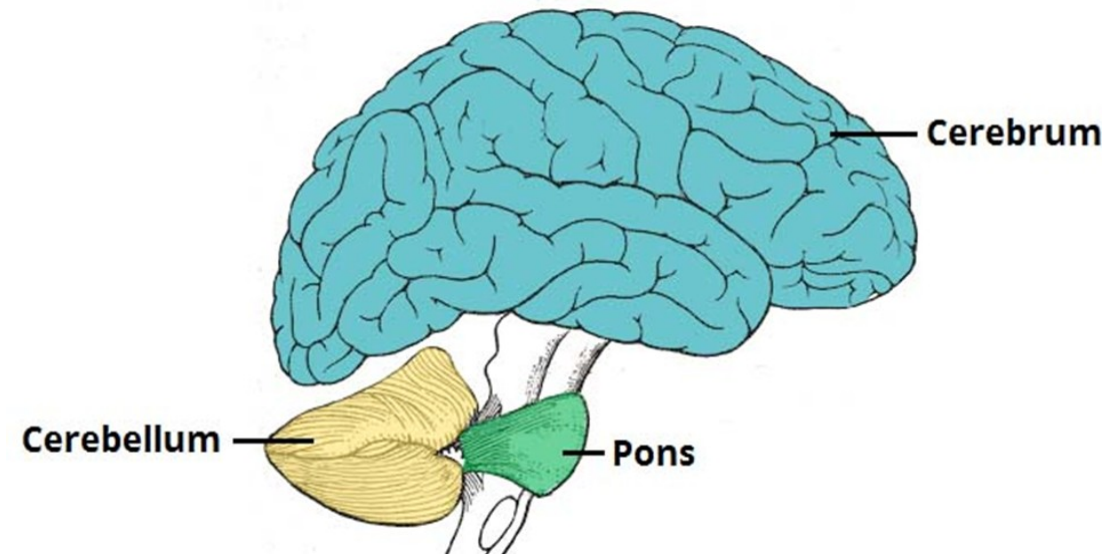


Functions of Cerebellum

- 1 Cerebellum maintains equilibrium of body.
2. It maintains muscle tone.
3. Cerebellum coordinates subconscious movements of skeletal muscles.

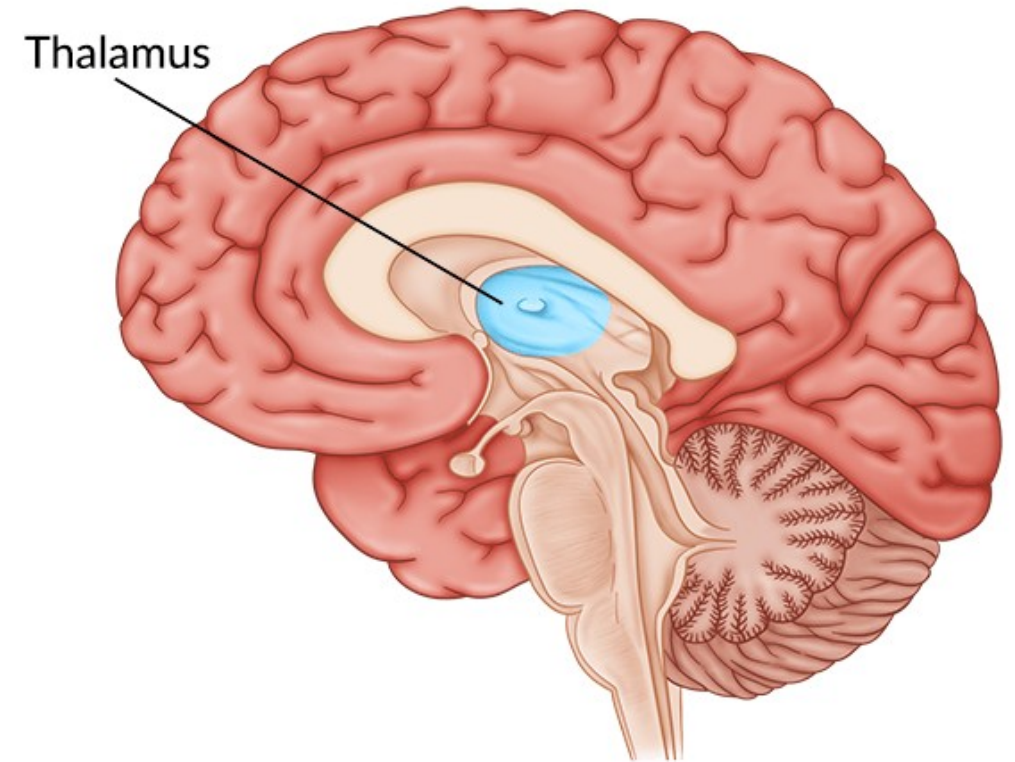
Clinical Importance

- Disturbance in walking, dizziness indicates damage to cerebellum.



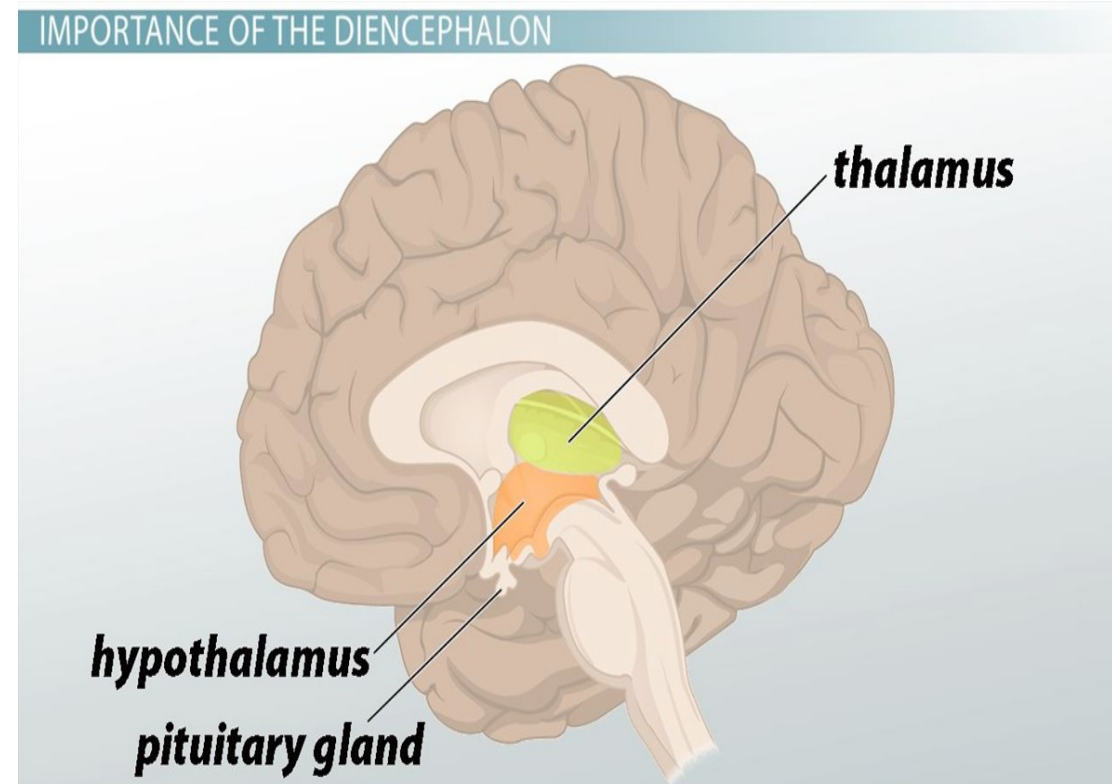
Functions of Thalamus

1. Thalamus is a relay station for sensations of touch, pain, pressure, vision, sound and taste.
2. Only the sensation of smell is not conducted in the thalamus.
3. Thalamus conveys sensations to cerebrum.
4. Anterior nucleus of thalamus is related to emotions and brains.
5. Thalamus interprets the sensation of pain, touch, pressure and temperature.

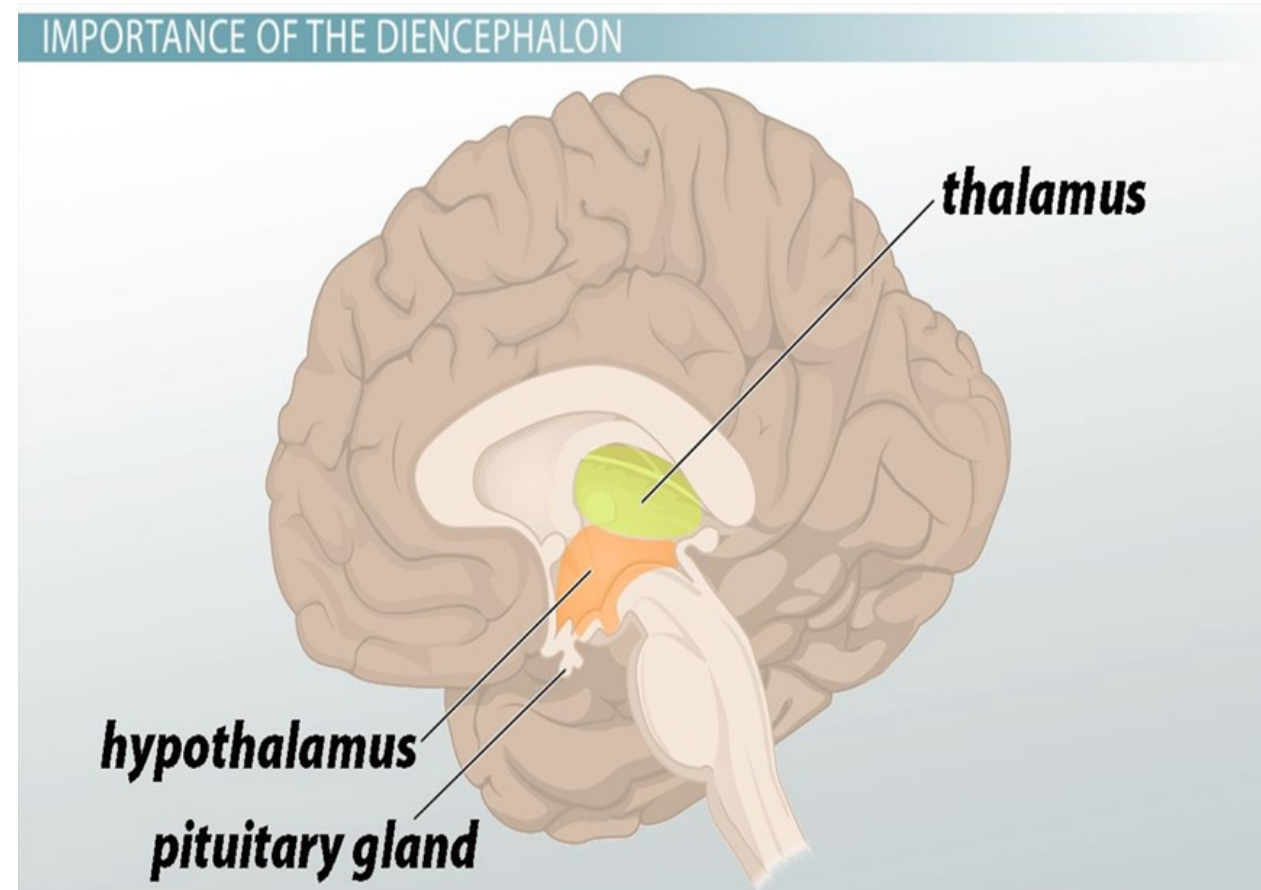


FUNCTIONS OF HYPOTHALAMUS

1. Hypothalamus is located below the thalamus
2. Hypothalamus controls normal body temperature.
3. Hypothalamus controls food intake.
4. Satiety center in hypothalamus gives feeling of satiety.
5. Feeding center of hypothalamus regulated hunger.
6. Thirst center is present in hypothalamus. Reduced extracellular fluid volume stimulated thirst center. Thirst



7. Hypothalamus maintains walking state and sleeping patterns.
8. Hypothalamus secretes regulatory or inhibitory hormones.
9. Hypothalamus controls autonomic nervous system.
10. Hypothalamus receives information from external environment.
11. Hypothalamus controls sexual behaviour.

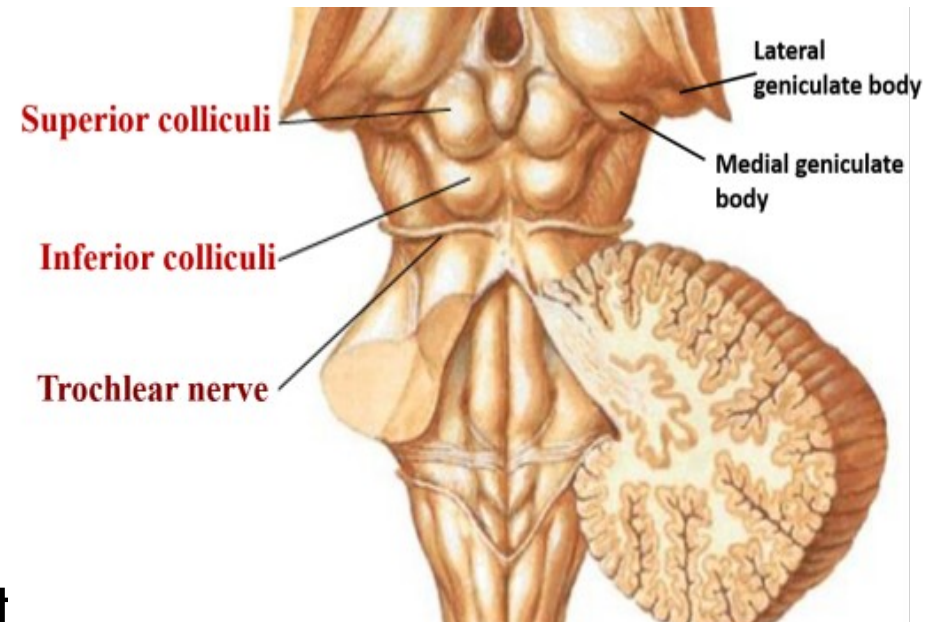
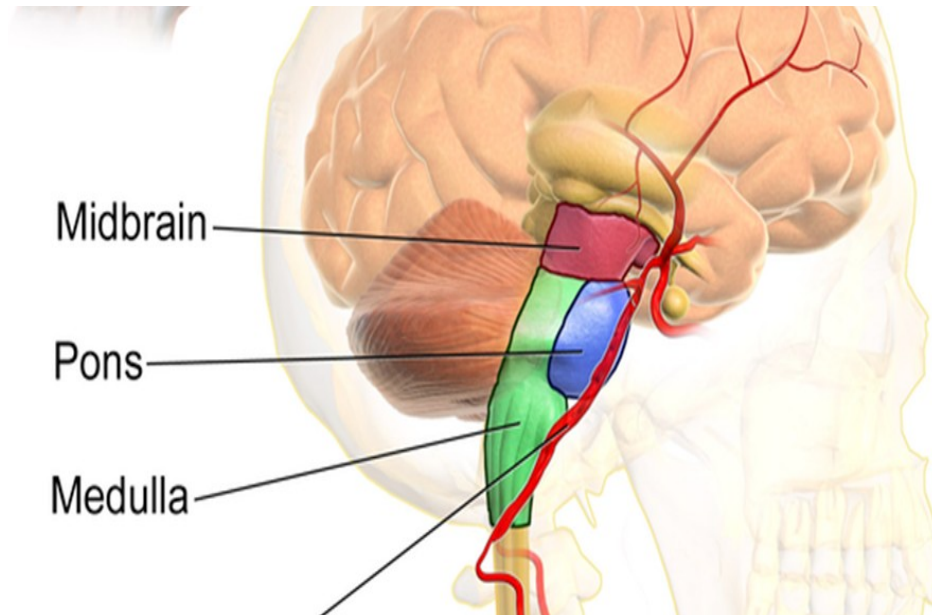


FUNCTIONS OF MIDBRAIN

- The midbrain extends from the pons to the lower part of diencephalon.

FUNCTIONS

- Four eminences on the dorsal portion of the midbrain are called as
(i) Superior colliculli (ii) Inferior colliculli.
- Superior colliculli are reflex centers for (i) Movements of eyeballs and (ii) Movements of head and neck in response to visual stimuli.
- Inferior colliculli are reflex centers for the movement of head and neck in response to auditory stimuli so person can head towards direction of sound.
- Red nucleus of midbrain gives origin to descending rubrospinal tract. Rubrospinal tract is an extra-pyramidal tract.

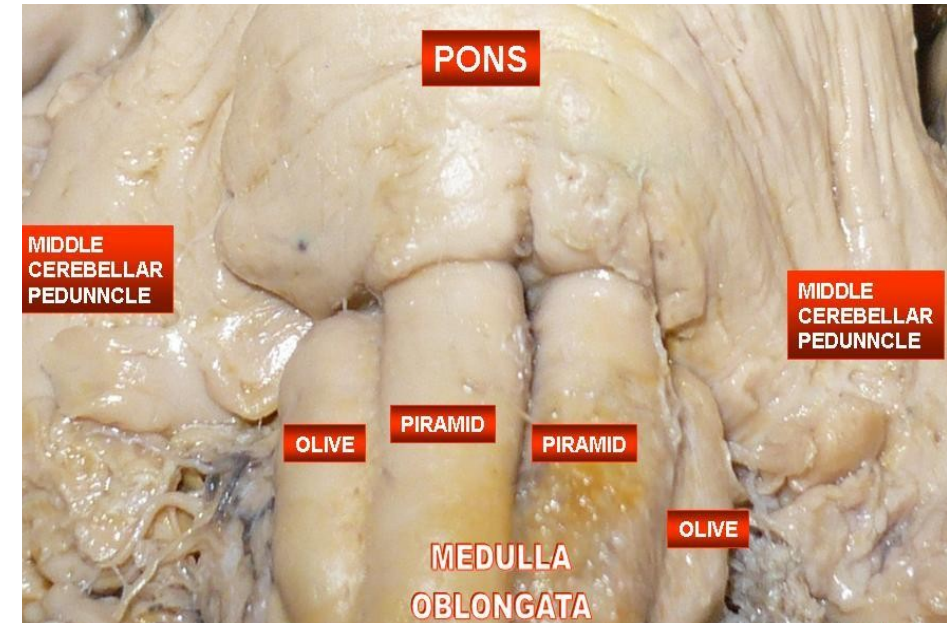
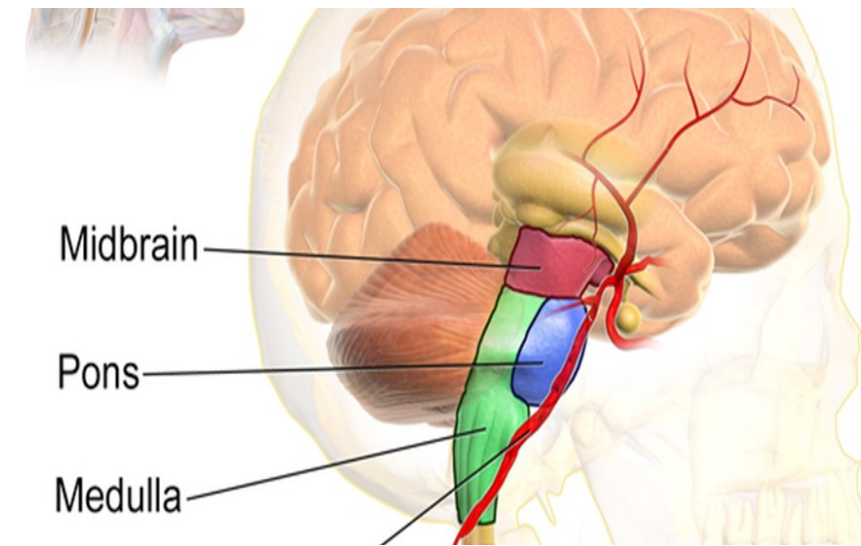


FUNCTIONS OF MEDULLA OBLONGATA

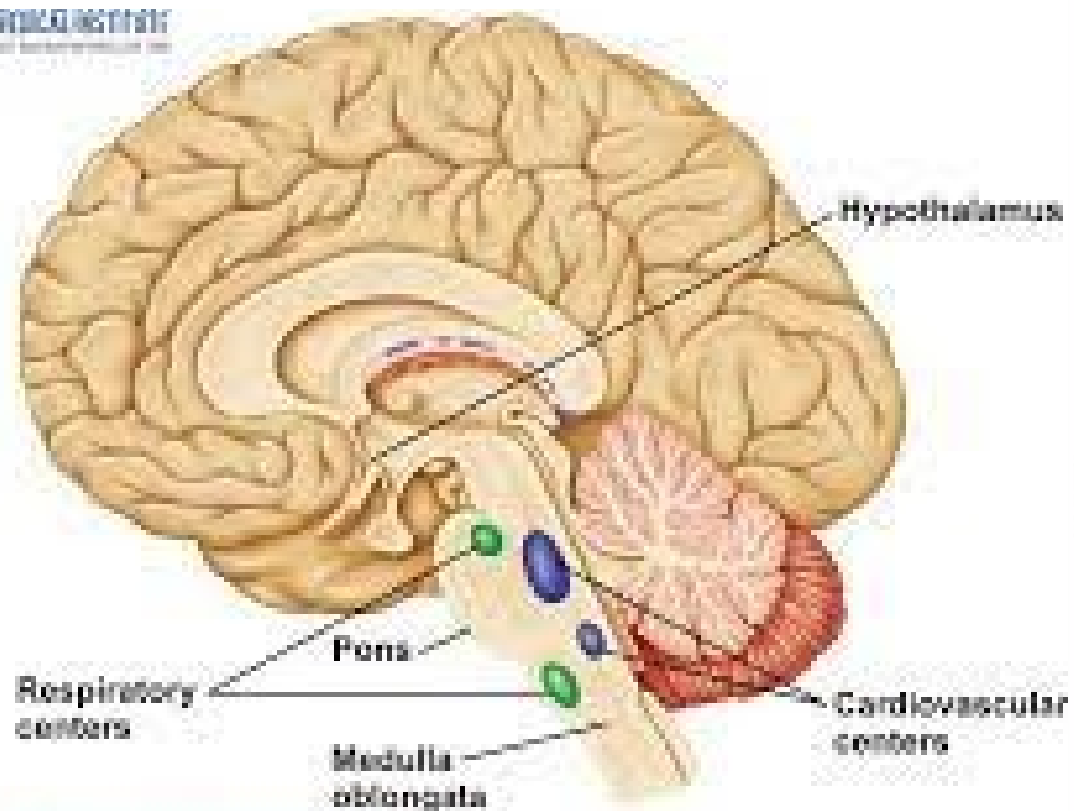
- Continuation of upper portion of spinal cord is called as medulla oblongata.

FUNCTIONS

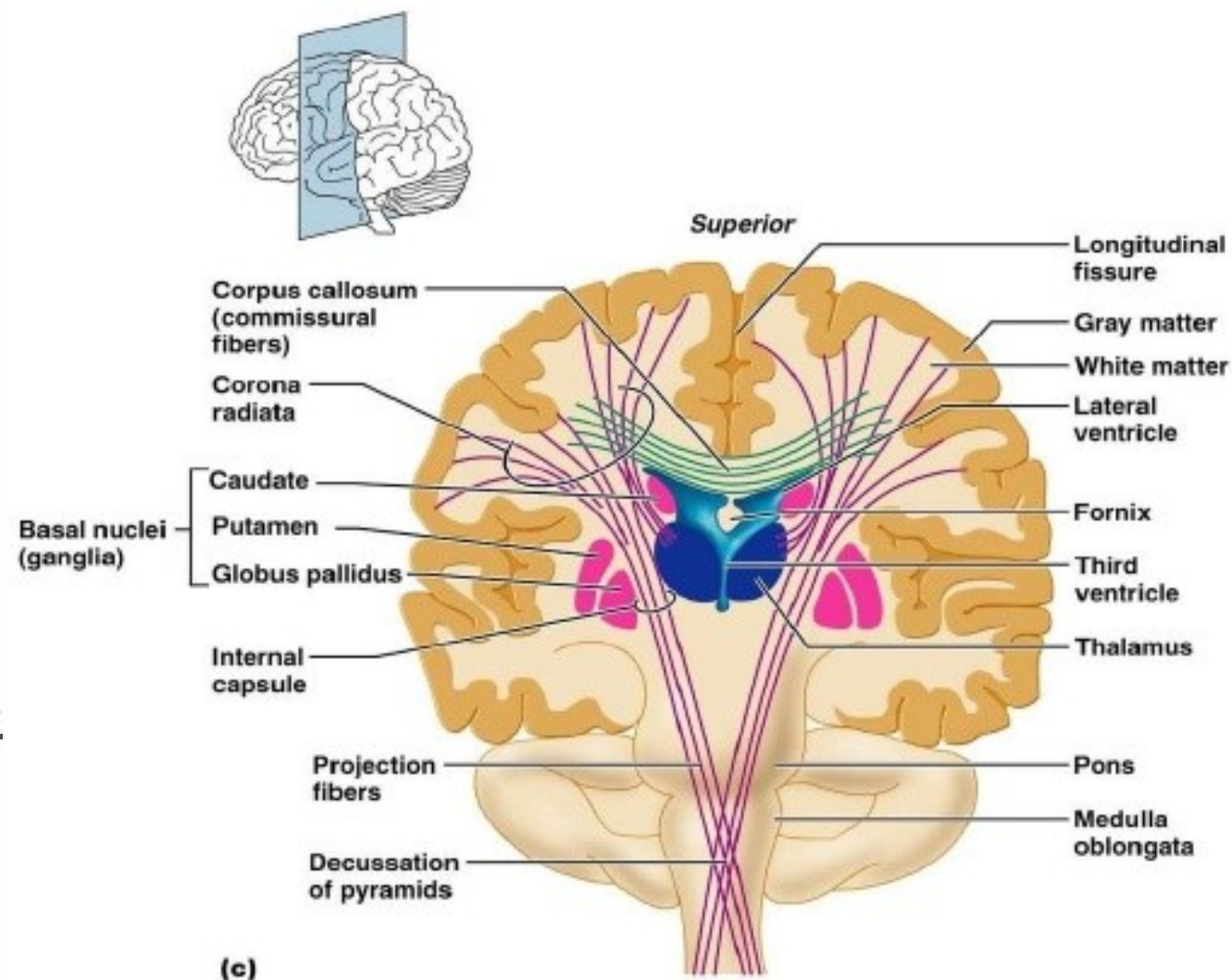
- Triangular structures on the ventral surface of the medulla are called as pyramids.
- Nerve fibres of descending tracts coming from cerebrum decussate (cross) in the pyramids and pass to the spinal cord.
- Fibres from the left pyramids cross to right side of the spinal cord and fibres from the right pyramid cross to the left side of spinal cord



- Due to decussation of motor fibres in pyramids, motor area of left cerebral cortex controls right side of the body and right cerebral cortex controls left side of the body.
- **Dorsal surface** of medulla receives sensory nerve fibres from ascending right and left **fascicular gracilis** and **fascicular cuneatus**.
- **Cardiac center** of medulla controls heart rate.
- **Medullary rhythmicity** area adjust the basic rhythm of breathing.
- **Vasomotor center** regulates diameter of blood vessels.
- **Reflex centers** for swallowing, vomiting, coughing, sneezing and hiccup are present in the medulla.

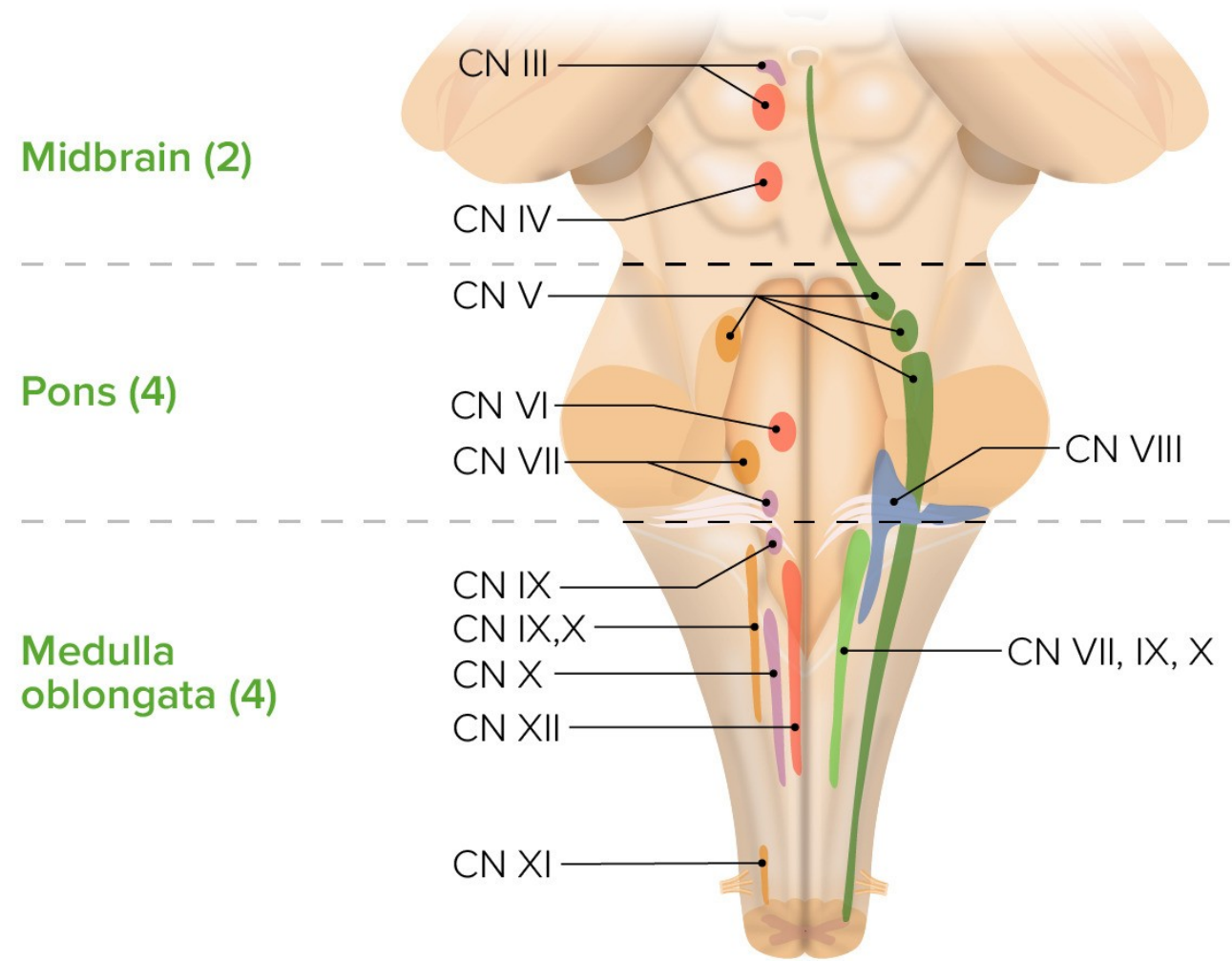


Decussation of the Pyramids



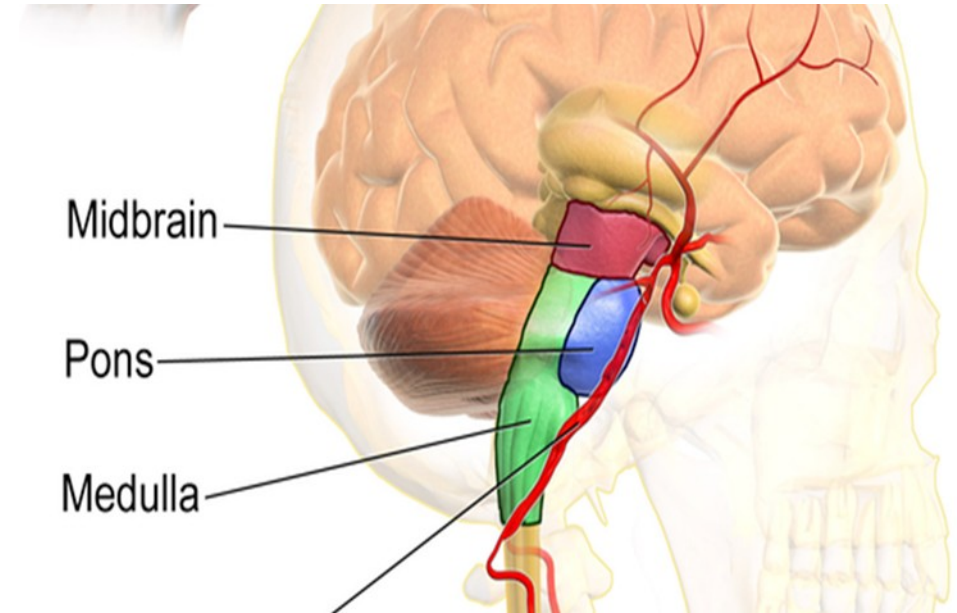
Nuclei of following cranial nerves are present in the medulla.

- Vestibulo - Cochlear nerves (VIII)
- Glossopharyngeal nerves (IX)
- Vagus nerves (X)
- Accessory nerves (XI)
- Hypoglossal nerves (XII)



FUNCTIONS OF PONS

- Pons connects spinal cord with brain functions.
- Pneumotaxic area and apneustic area of pons controls movements of breathing.
- Pons together with medullary rhythmicity area control respiration.

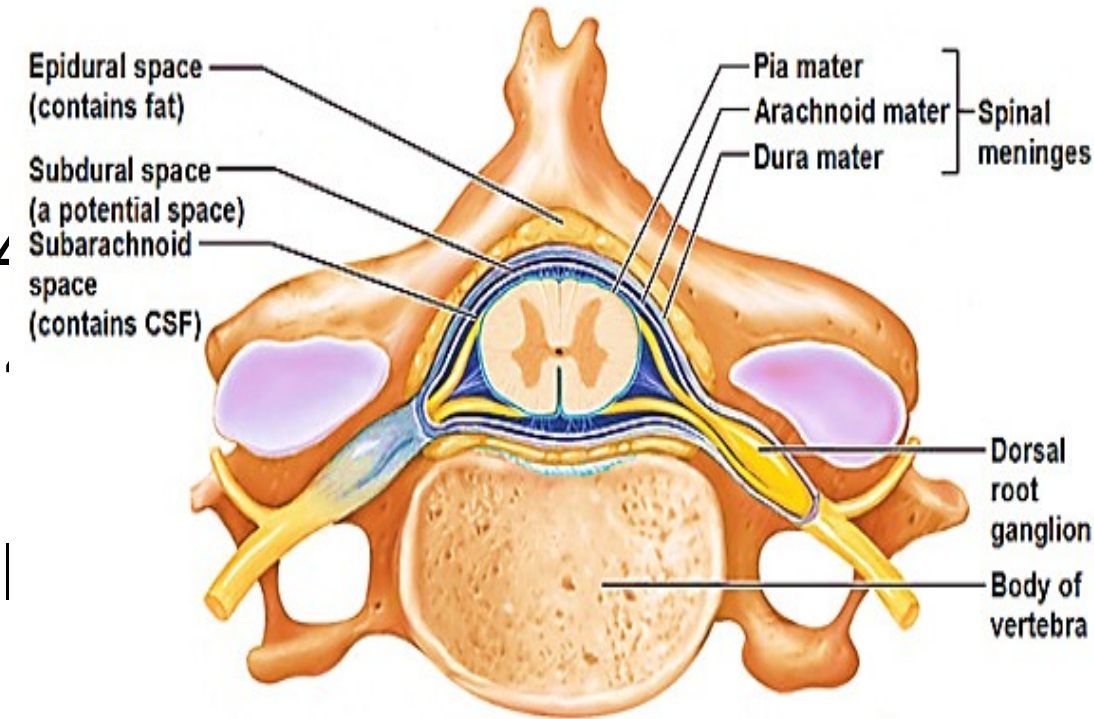


FUNCTIONS OF SPINAL CORD

- Location – Vertebral column
- Length of the adult spinal cord – 42-44 cm
- Circumference of the spinal cord-2.5 cm

Meninges(coverings) of the spinal cord

- 1.Dura mater-Outer most covering
- 2.Arachnoid mater-Middle covering
- 3.Pia mater-Inner covering

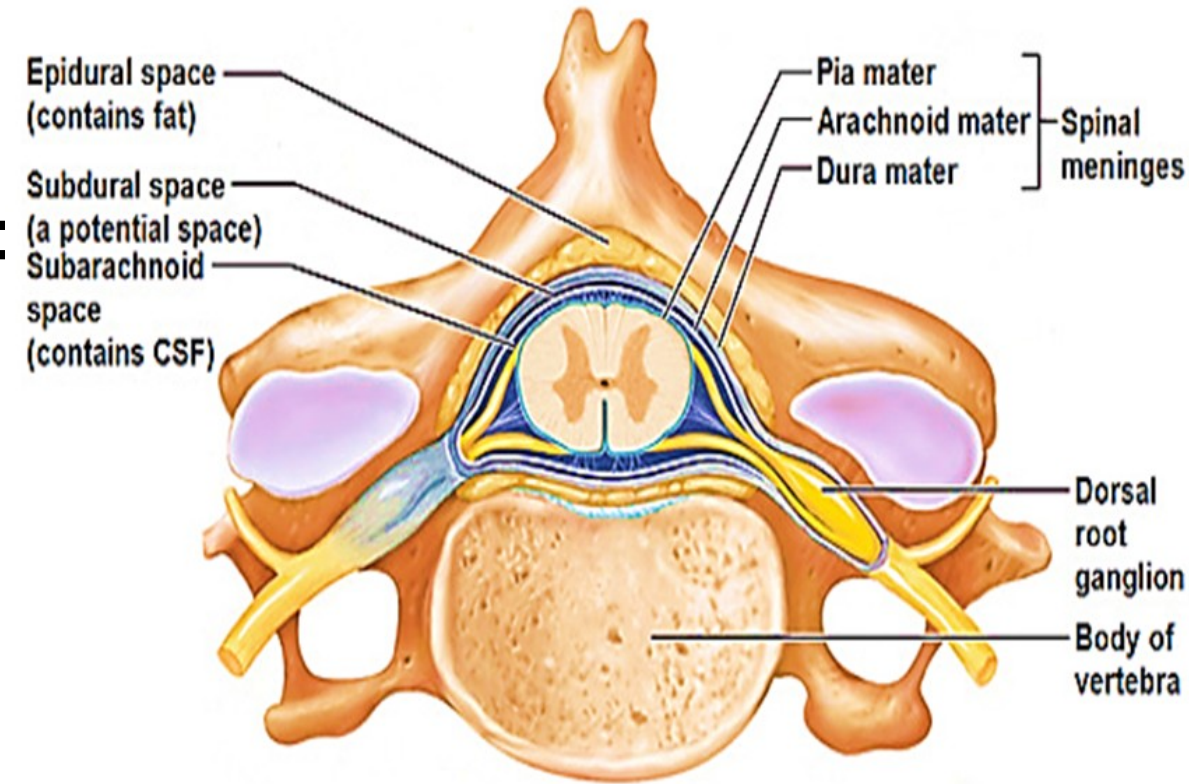


- **Epidural space:** Space between the wall of vertebral column and dura mater is known as epidural space.

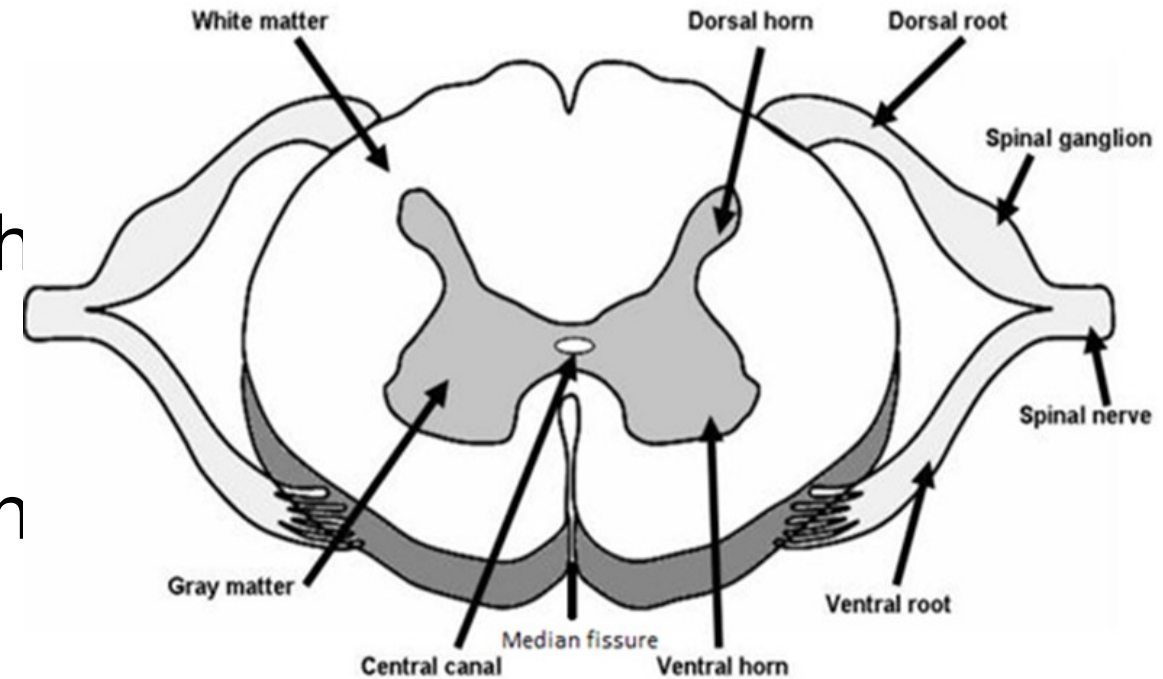
- **Importance of epidural space:** The epidural space inferior to the second lumbar vertebra is the site for epidural anaesthesia.

- **Subarachnoid space:** The space between pia mater and arachnoid mater is called as subarachnoid space. Cerebrospinal fluid circulates in this space.

- **Importance of subarachnoid space:** Spinal anaesthesia is

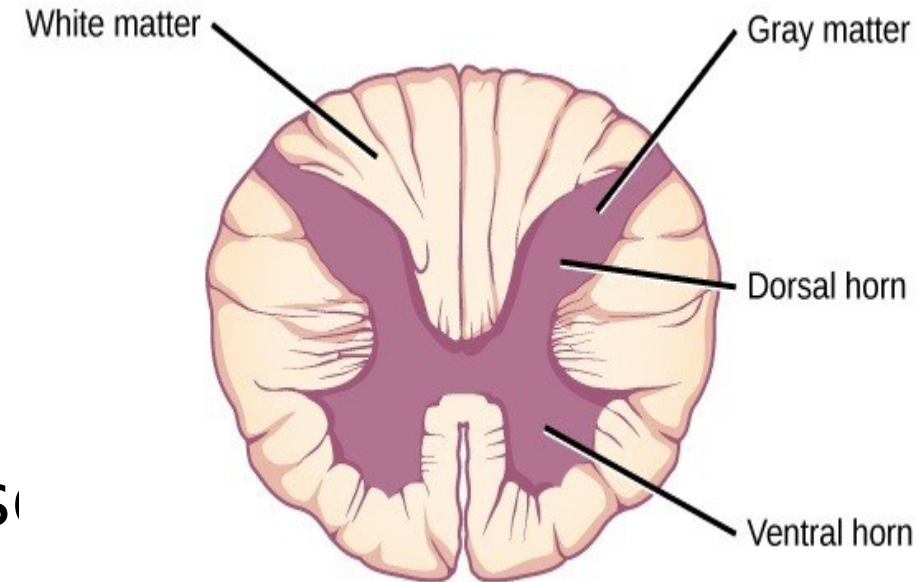


- Inner part of spinal cord consists of gray matter.
- Shape of gray matter of cord is like the English alphabet H.
- Gray matter consists of nerve cell bodies.
- The small space in the center of the gray matter is called as **central canal**.
- Central canal contains cerebrospinal fluid.
- Central canal is continuous with the fourth ventricle of the medulla.
- Divisions of gray matter are:
 - Anterior gray horns.



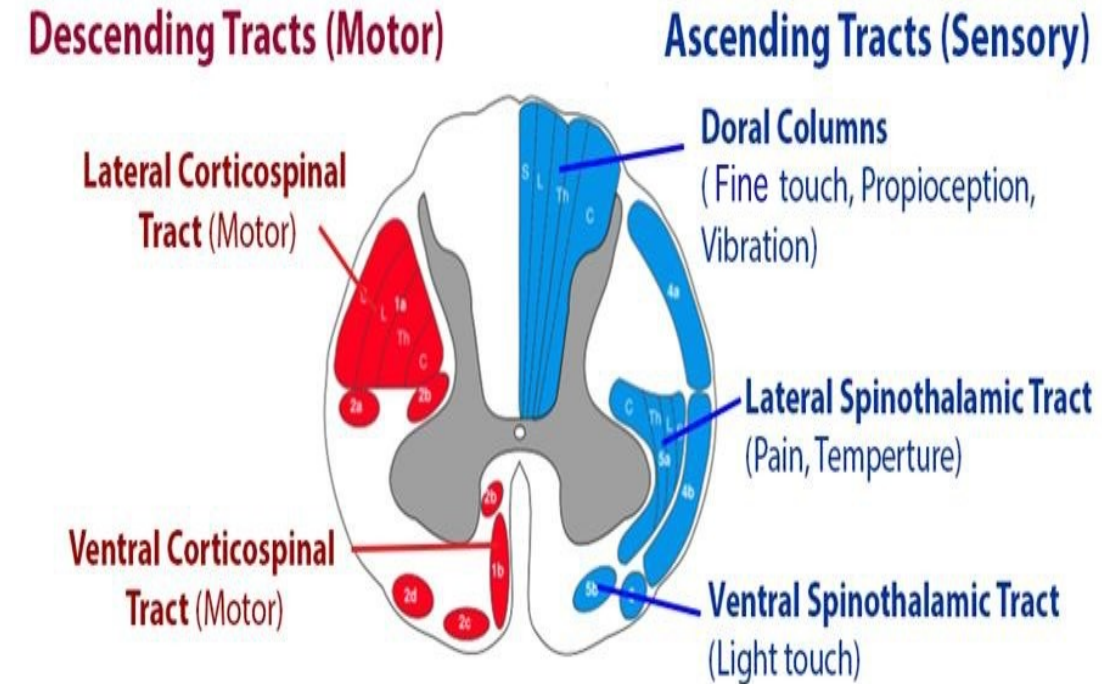
Cross section of Spinal cord

- Gray horn contains nuclei which give origin to nerve fibres.
- Lateral gray horn cells(nuclei) are present only in thoracic, lumbar and sacral segments of cord.
- The outer part of the spinal cord consists of white matter.
- The white matter is formed of sensory and motor tracts of the spinal cord.
- White matter is divided into
 1. Anterior (ventral) white column.
 2. Posterior(dorsal) white column.
 3. Lateral white column.
- White columns consist of ascending(sensory) and descending(motor) tracts.
- Myelin sheath of tracts gives white colour to the outer part of spinal cord.



FUNCTIONS OF SPINAL CORD

1. Ascending tracts (sensory tracts) of spinal cord conducts sensory impulses from various parts of body to brain.
2. Descending tracts (motor tracts) convey motor impulses from brain to muscles and various parts of body.
3. Spinal segments give rise to 31 pairs of spinal nerves.
4. The ventral rami of spinal nerves(except T2,T11) from various nerve plexuses such as cervical plexus, sacral plexus etc.
5. Dermatomes of all spinal

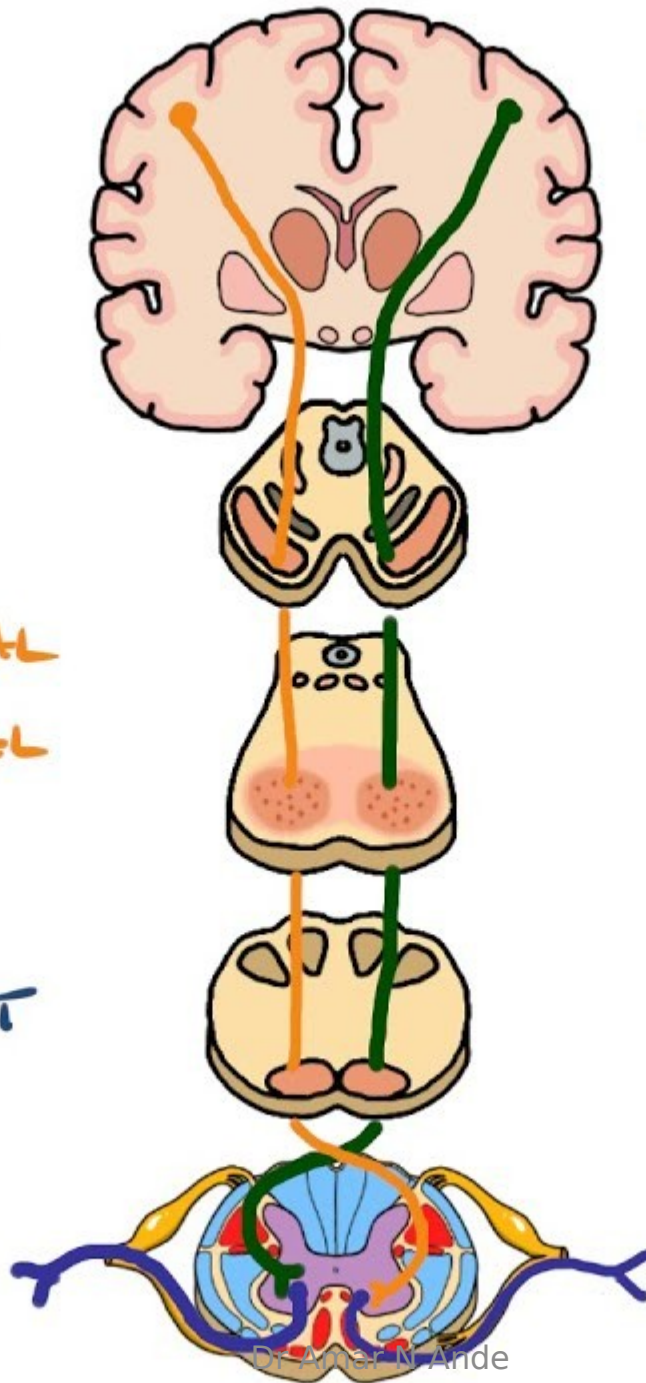


Descending (Motor) Tracts

- Descending tracts conduct motor impulses from brain to periphery
- Types of descending tracts:-
 1. Pyramidal (arise from cerebral cortex)
 2. Extrapyramidal (arise from mid brain)
- Names of pyramidal tracts
 1. Lateral corticospinal tract
 2. Anterior (ventral) corticospinal tract.

PYRAMIDAL

- ① **CORTICOSPINAL TRACT**
VOLUNTARY CONTROL
 - BODY**LATERAL CORTICOSPINAL**
ANTERIOR CORTICOSPINAL
- ② **CORTICOBULBAR TRACT**
VOLUNTARY CONTROL
 - FACE, HEAD, NECK



EXTRAPYRAMIDAL

- 1) **RUBROSPINAL**
FINE MOTOR CONTROL
- 2) **RETICULOSPINAL**
MEDIAL - CONTRACTION INCREASES TONE
LATERAL - RELAXATION DECREASES TONE
- 3) **VESTIBULOSPINAL**
BALANCE AND POSTURE
- 4) **TECTOSPINAL / COLLICULOSPINAL**
HEAD CO-ORDINATION

FUNCTIONS OF PYRAMIDAL TRACTS

- Descending pyramidal tract controls skeletal muscles of opposite side of the body.
- Coordination of discrete movement.
- Coordination of movements of axial skeleton.

NAMES AND ORIGIN OF EXTRA PYRAMIDAL TRACT

Name	Origin
1. Rubrospinal tract	Midbrain
2. Tectospinal tract	Midbrain
3. Vestibulospinal tract	Medulla
4. Lateral reticulospinal tract	Medulla Pons
5. Anterior reticulospinal tract	

- Rubrospinal and Tectospinal extra pyramidal tracts are crossed extrapyramidal tract hence they control opposite side of the body.

FUNCTIONS OF EXTRAPYRAMIDAL TRACT

- Vestibulospinal tract maintains equilibrium.
- Tectospinal tract controls movements of head in response to visual and auditory stimuli.
- Rubrospinal tract controls flexor muscle tone.
- Extra pyramidal tracts control complex movements of body such as movements of hands and legs while walking.

Cells of Nervous System

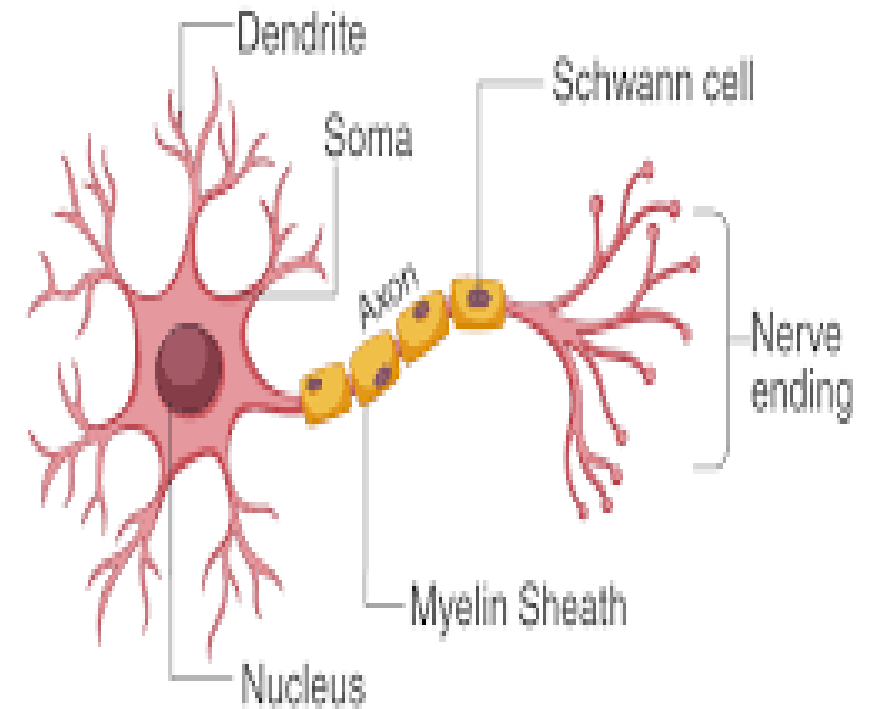
The cells of nervous system are called as

(1) Neurons and (2) Neuroglia.

Neurons:

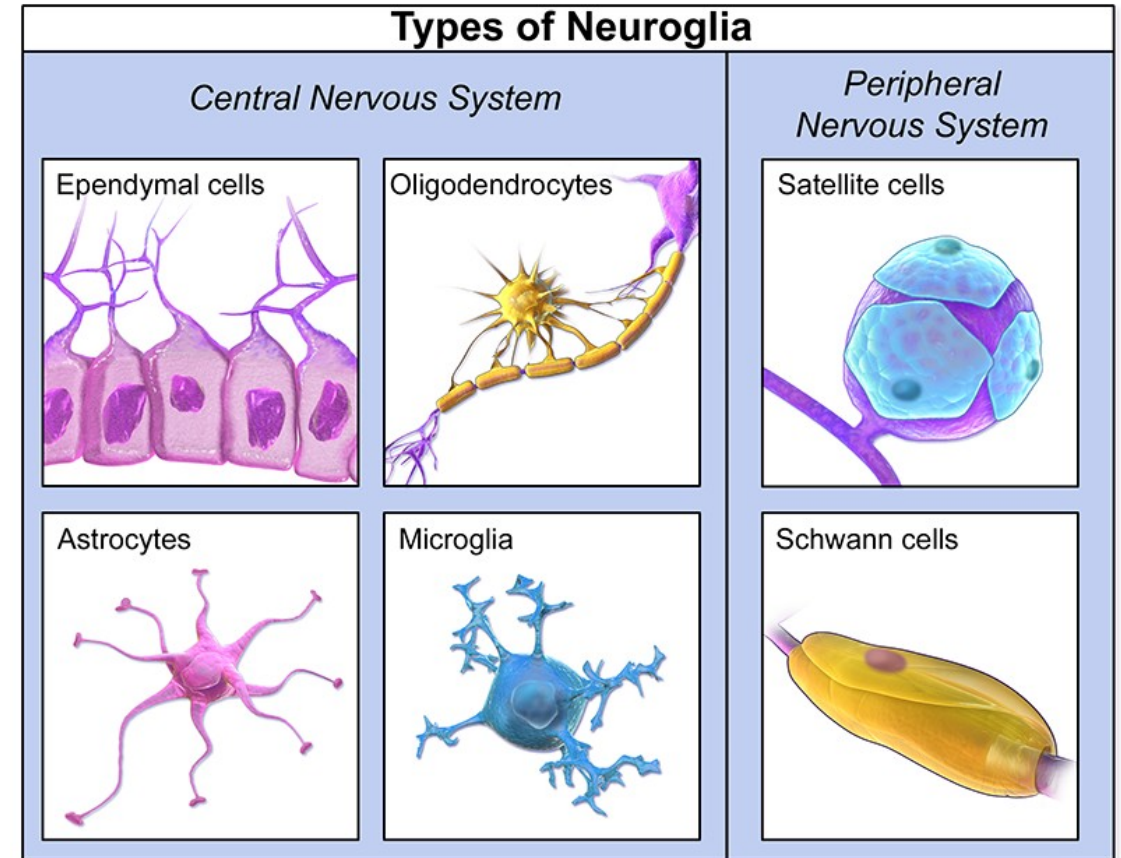
- a) Neurons are structural and functional cells of nervous system.
- b) Neurons conduct nerve impulses from one part of the body to another.

STRUCTURE OF NEURON

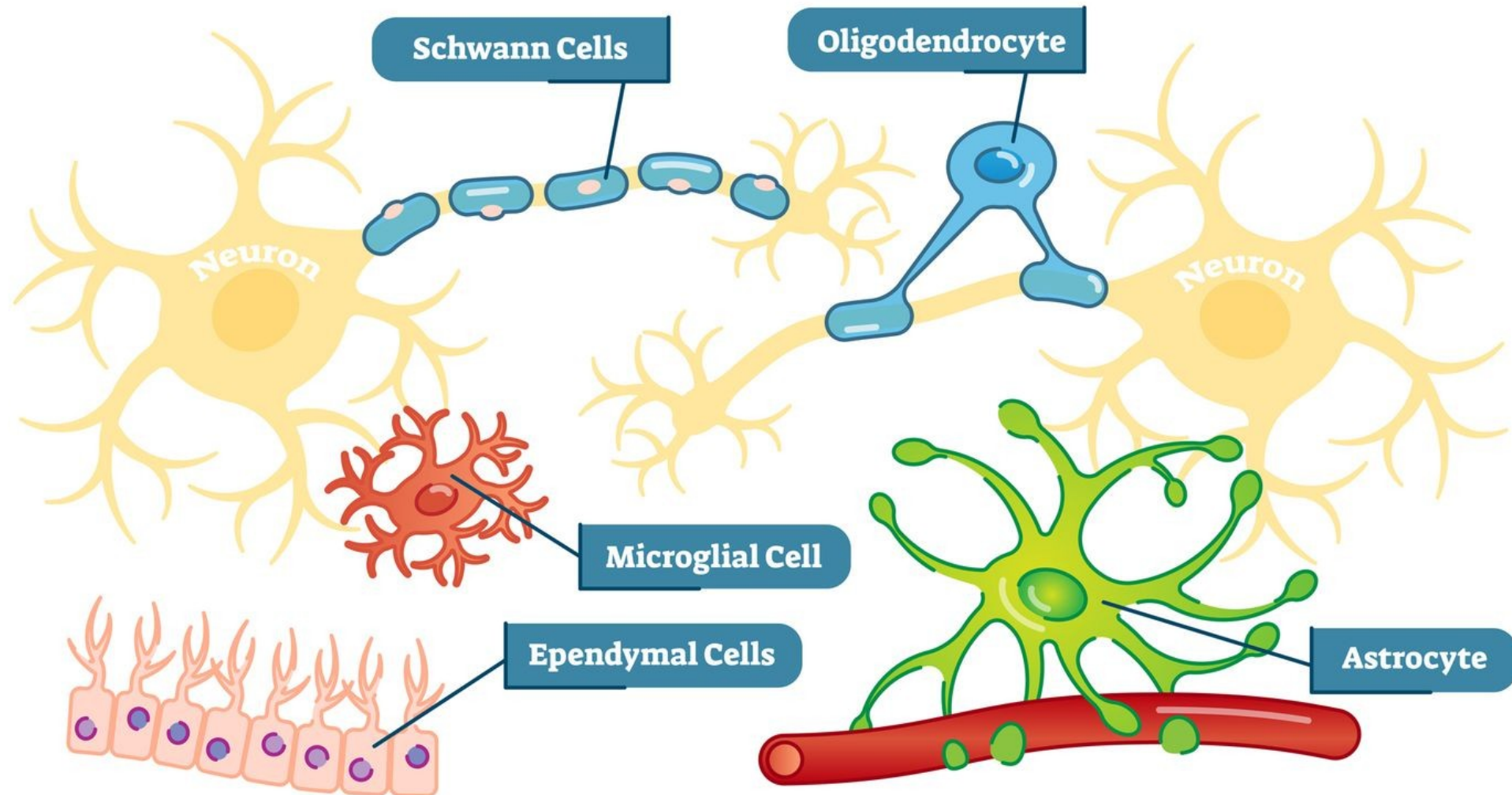


Neuroglia -

- a) Any of the cells that hold nerve cells in place and help them work the way they should.
- b) The types of neuroglia include oligodendrocytes, astrocytes, microglia, and ependymal cells.
- c) Also called **glial cell**.



Glial Cells

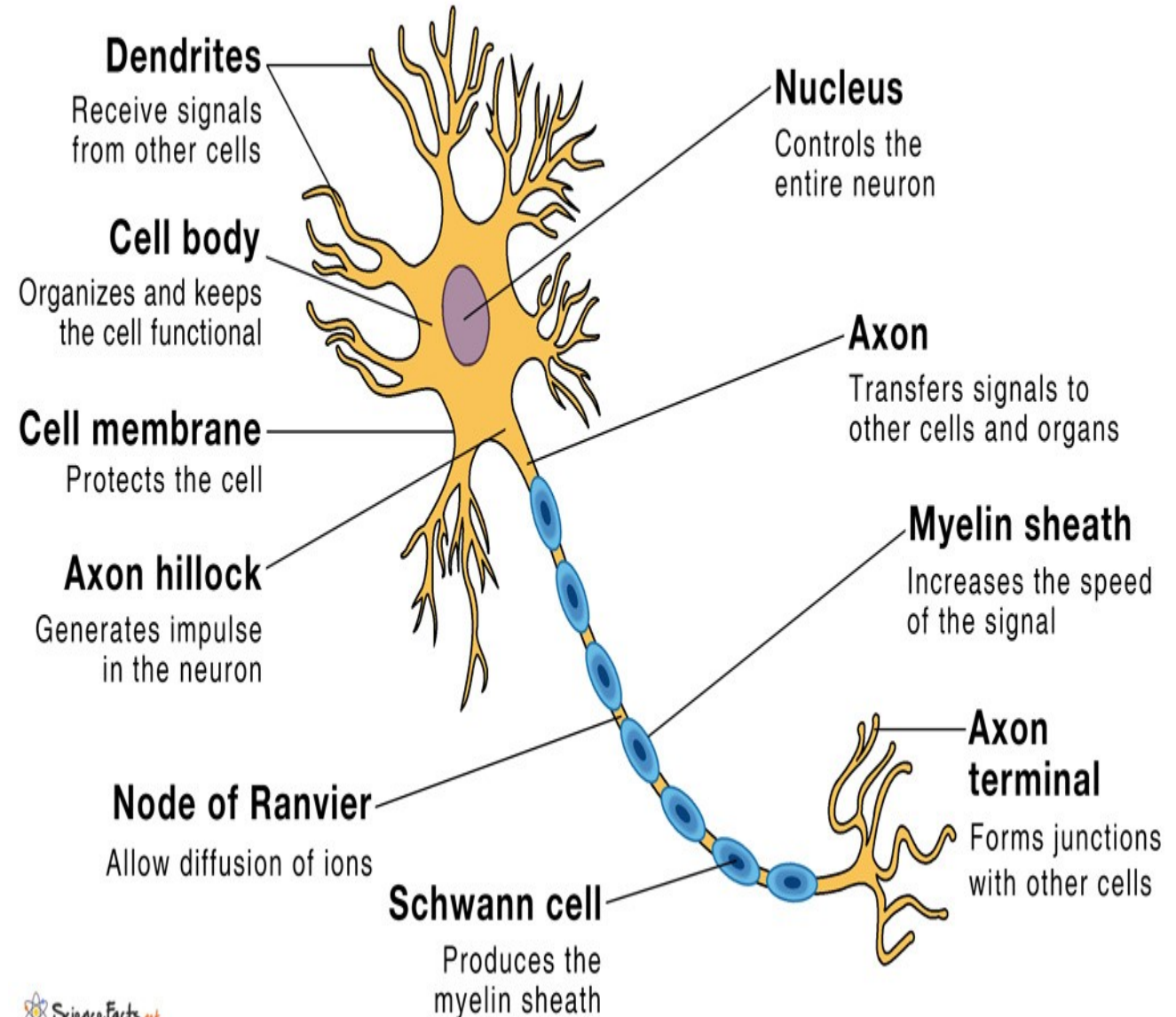


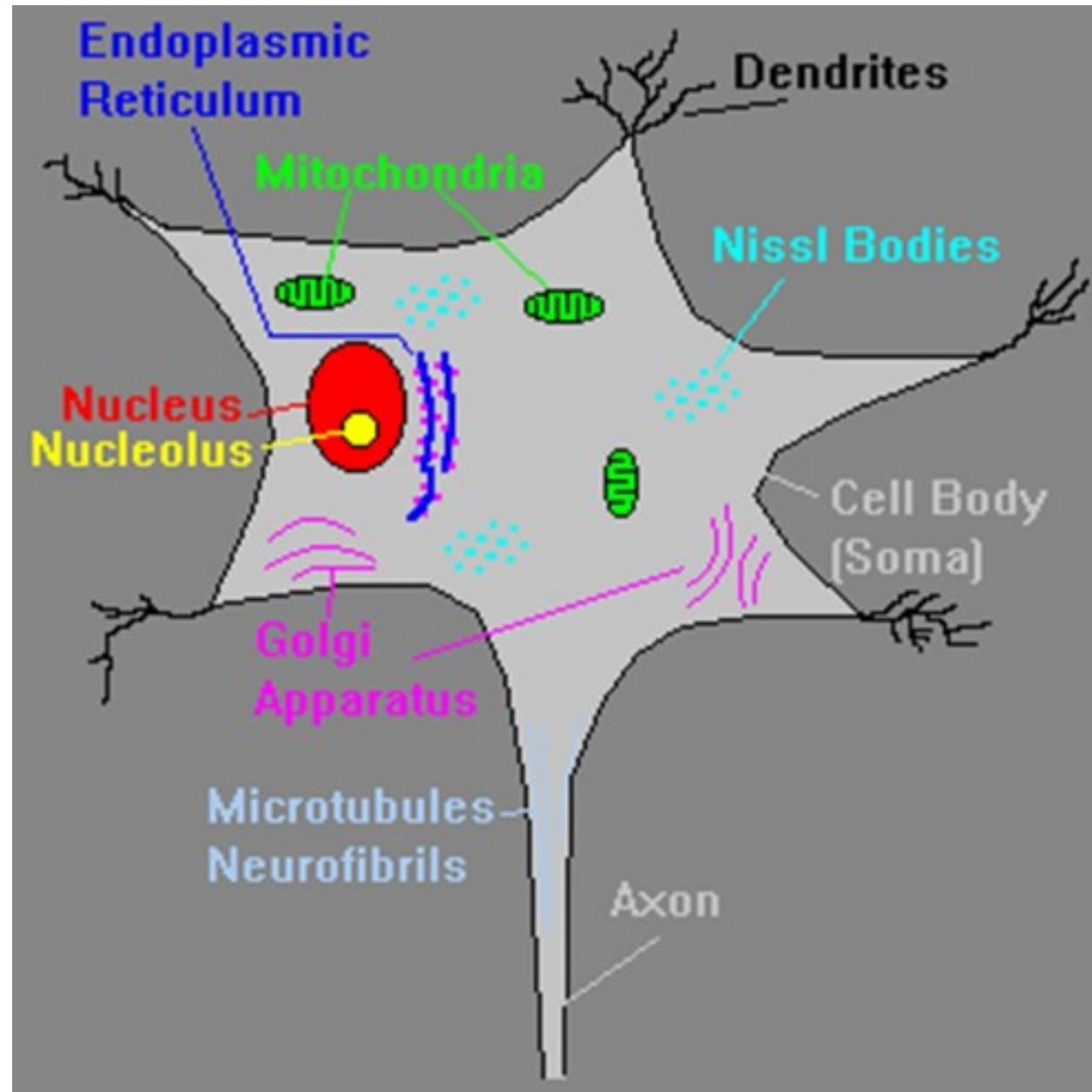
• **Parts of neurons:**

(1) Cell body (2) Dendrites
(3) Axon

- Cell body of neuron contains nucleus and granular cytoplasm.
- Cytoplasm consists of nucleus, lysosomes, golgi complex and Nissl's bodies.
- Function of Nissl's bodies is protein synthesis and regeneration of peripheral nerve fibers.

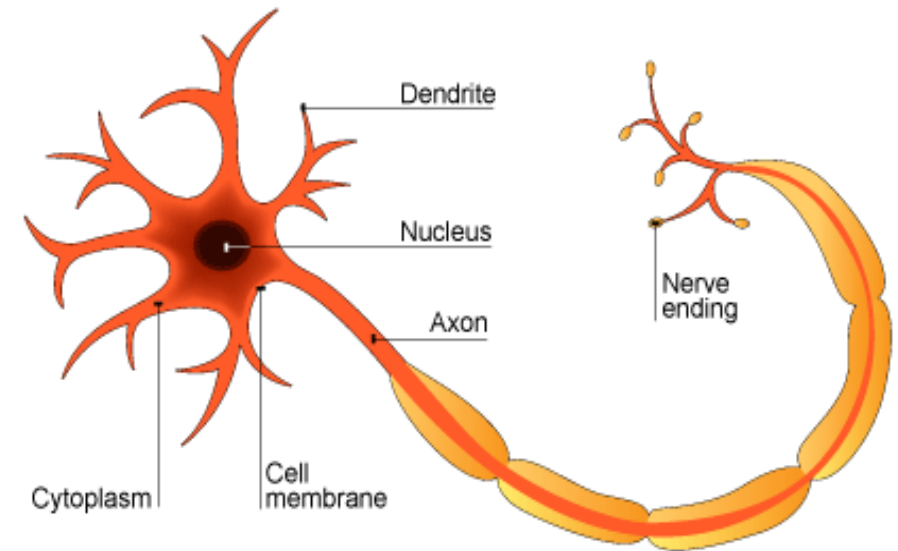
Parts of a Neuron with Functions



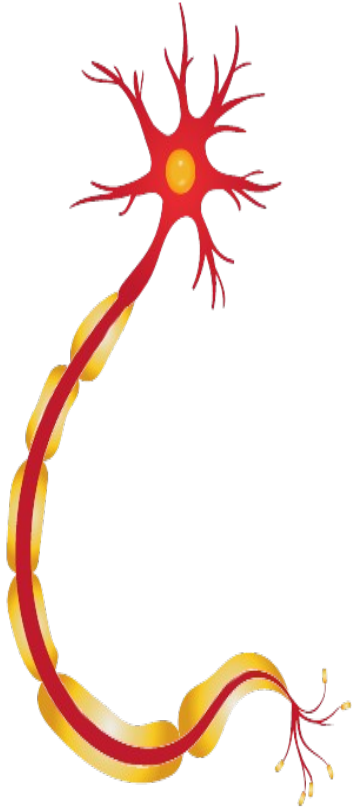


**Cytopla
sm**

- **Dendrites:** Dendrites are highly branched cytoplasmic processes.
- **Function of dendrites :** Dendrites conduct nerve impulse towards the cell body.
- **Axons:** Axon is a long cytoplasmic process.
- **Function of axon :** Axon conducts nerve impulse away from the cell body to another neuron or muscle or gland.
- **Nerve fiber :** Axon is called as nerve fiber.



Types of Nerve Fibres



Type A

Myelinated, large-diameter, high velocity



Type B

Myelinated, small-diameter, low velocity



Type C

Unmyelinated, small-diameter, low velocity

Types of Nerve Fibers

Myelinated
nerve fibers

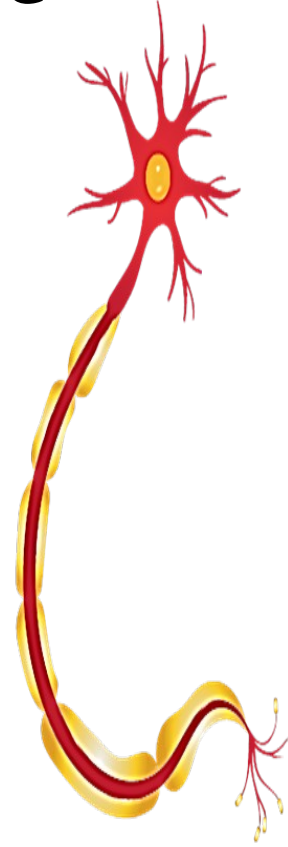
Non-
Myelinated
nerve Fibers

Myelinated nerve fibers:

- Nerve fibers or axons outside the brain and spinal cord are surrounded by myelin sheath.
- Axons of peripheral nervous system are myelinated.
- They have capacity of regeneration.

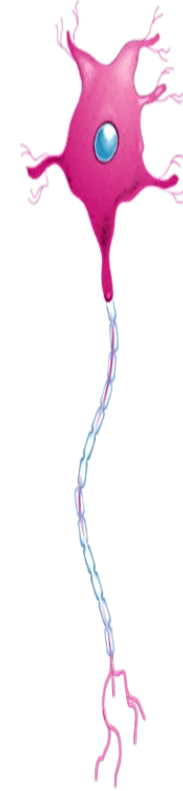
Non-myelinated nerve fibers:

- Axon without myelin sheath is called as non-myelinated.
- Non myelinated nerve fibers can not regenerate.



Type A

Myelinated, large-diameter, high velocity



Type B

Myelinated, small-diameter, low velocity



Type C

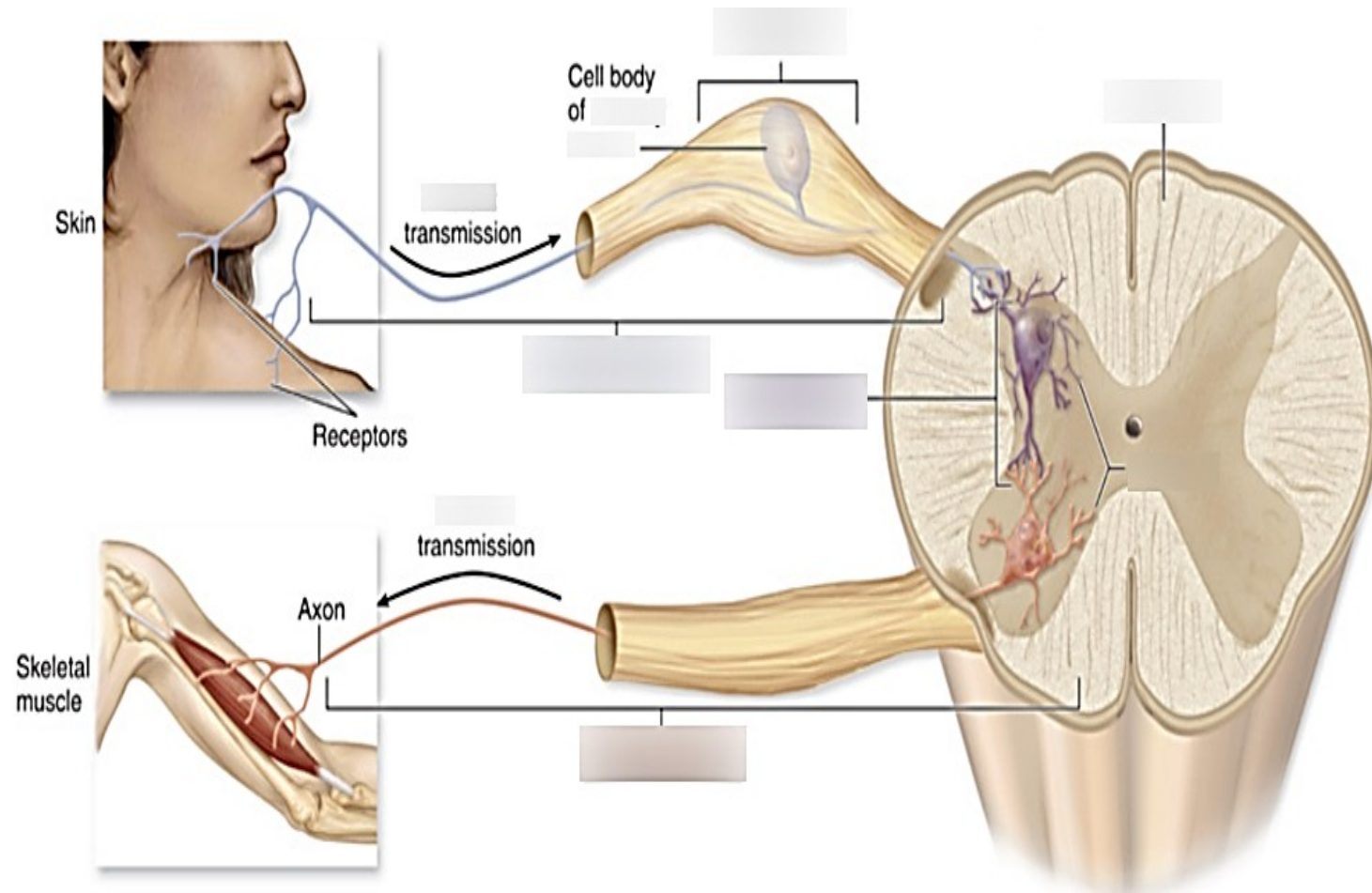
Unmyelinated, small-diameter, low velocity

Functional Classification of Neurons

1. Sensory neurons (Afferent neurons): Convey impulses from skin, muscles, or joints to brain and spinal cord.

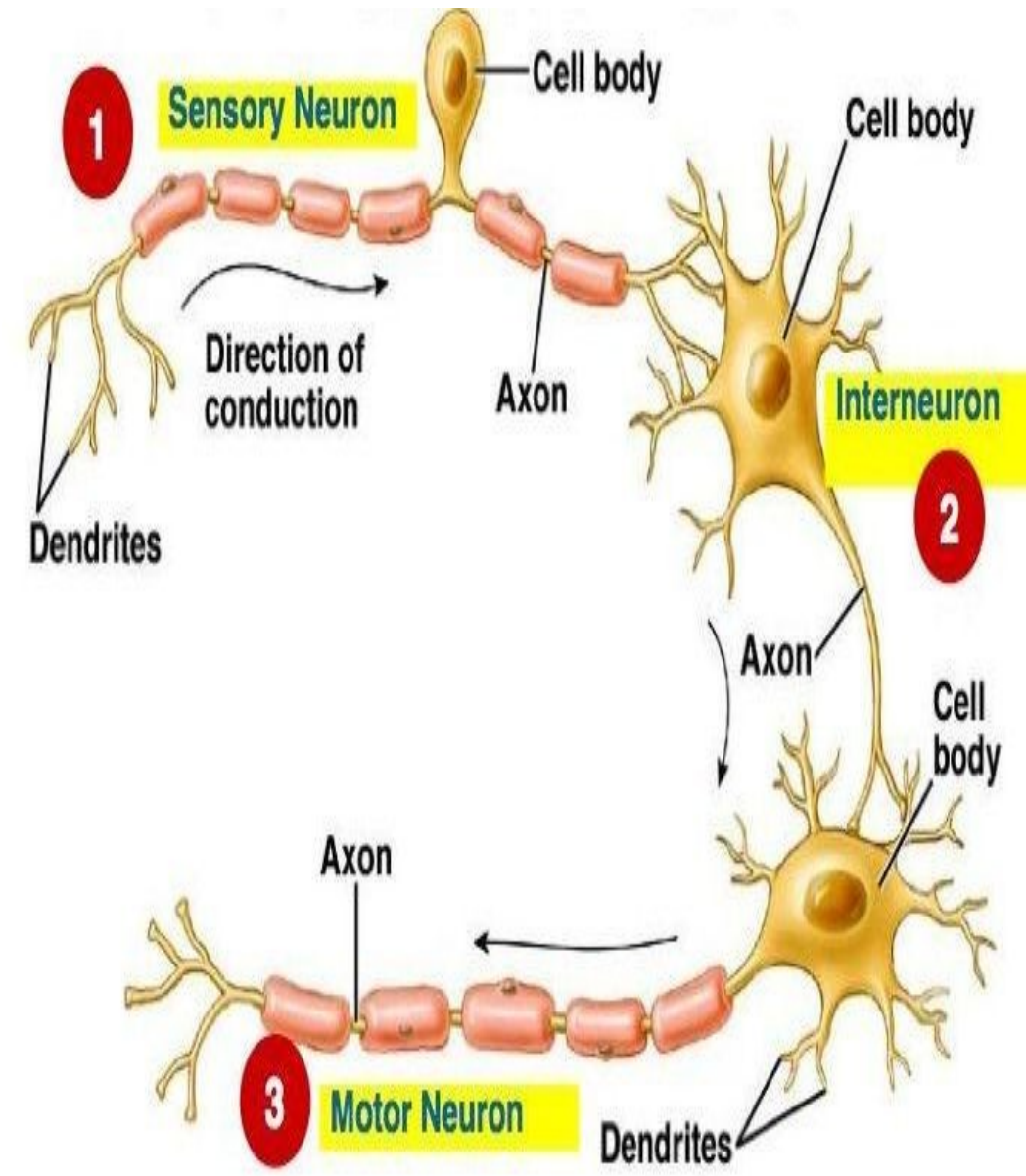
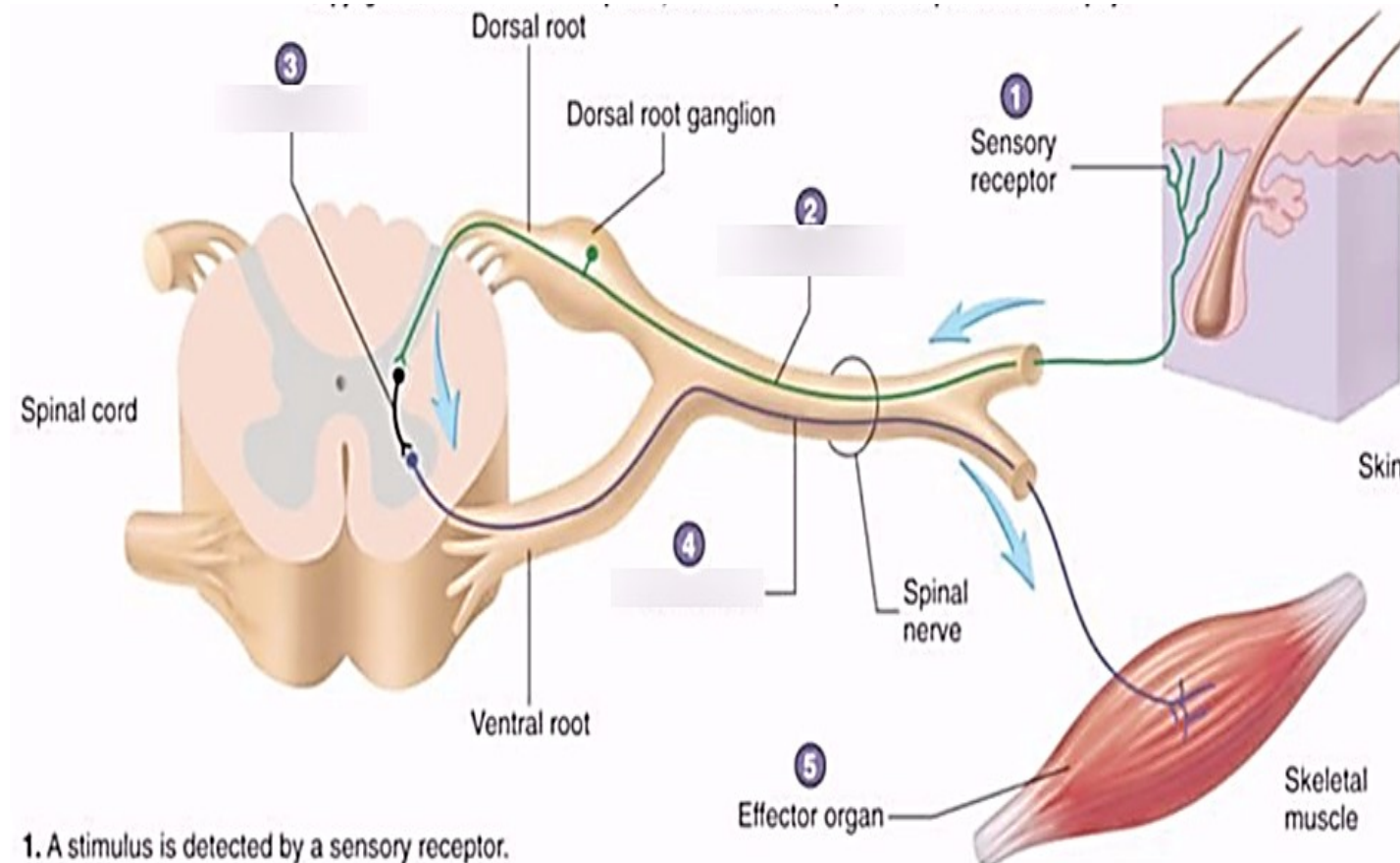
2. Motor neurons (Efferent neurons): Convey impulse from brain, spinal cord to muscles, skin and glands.

3. Association neurons: Carry impulses from sensory to motor neuron.



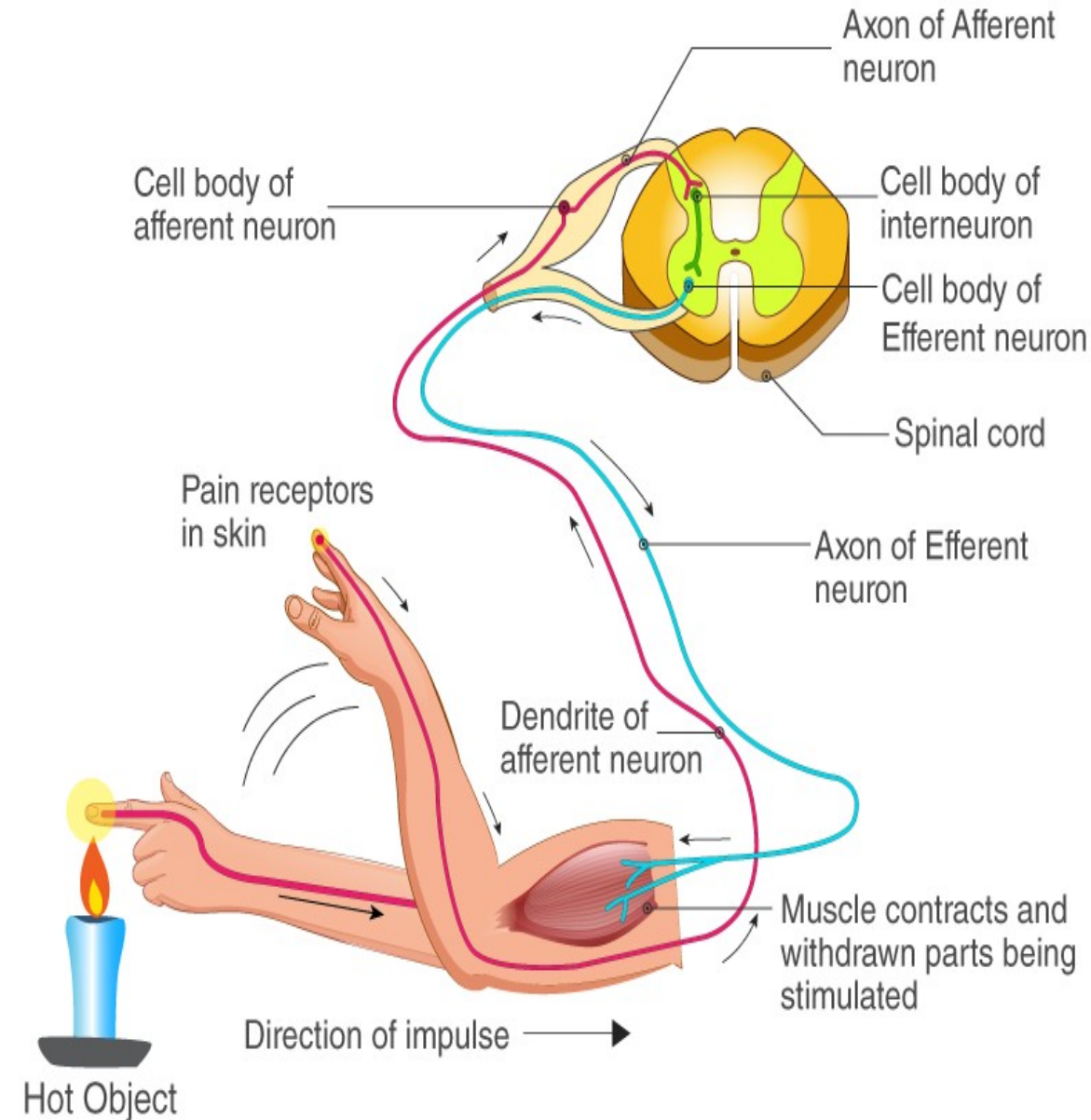
Functional Classification of Neurons

- Sensory/afferent neurons
- Motor/efferent neurons
- Inter/association neurons



REFLEX ACTION

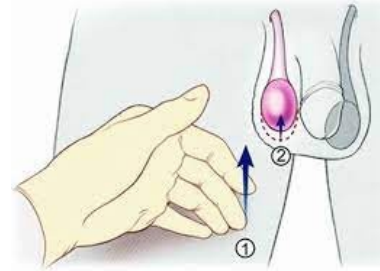
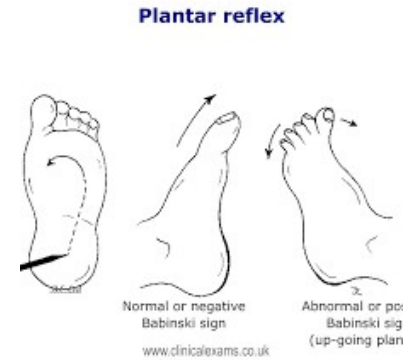
- **Definition:** Reflexes are the fast responses of the body to certain changes in the external or internal environment.
- **Example of reflex action:** Taking away hand quickly from the pricking needle.
- **Types of Reflexes:**
 - Somatic (Results in contraction of skeletal muscle)
 - Visceral (Related to heart rate, respiration, sneezing, etc)



Somatic reflexes :

- Superficial reflexes

1. Corneal
2. Pupillary
3. Planter
4. Abdominal
5. Scrotal



- Deep reflexes

1. Triceps reflex
2. Biceps reflex
3. Knee jerk
4. Ankle jerk
5. Jaw jerk



Biceps reflex
C5,6



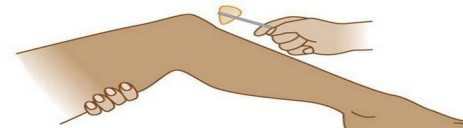
Brachioradialis reflex
C5,6



Triceps reflex
C7,8



Quadriceps reflex
L3,4



Dr Amar N Ande

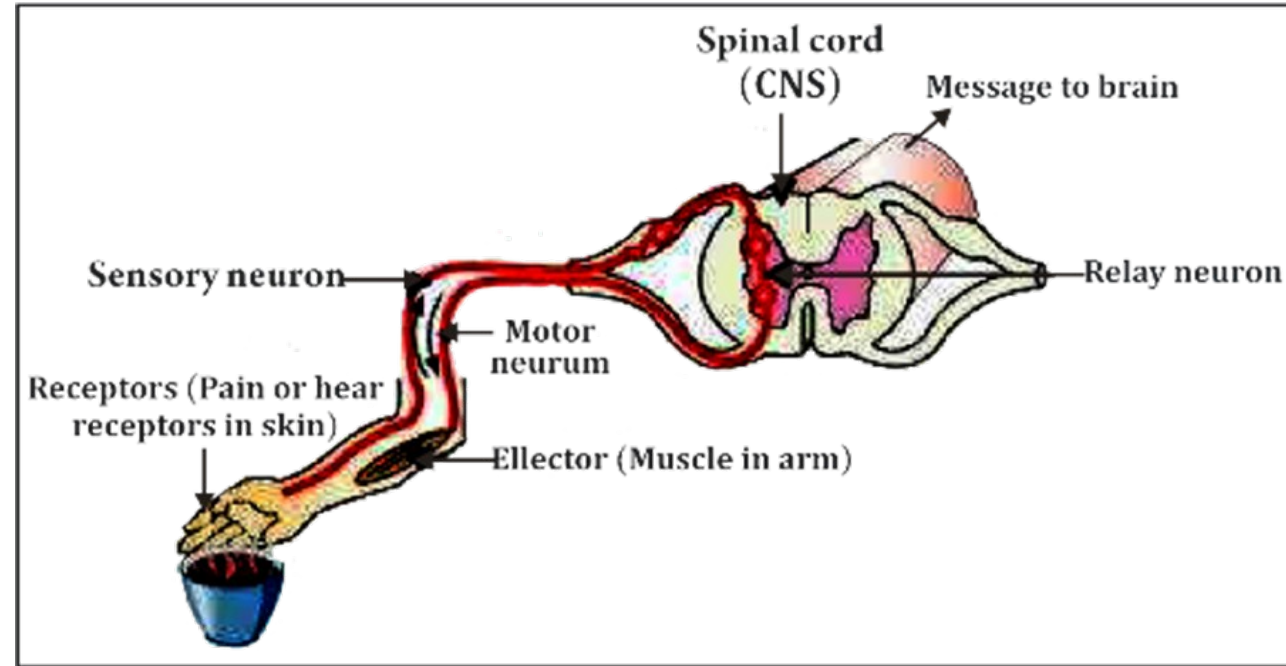


Achilles reflex
S1,2



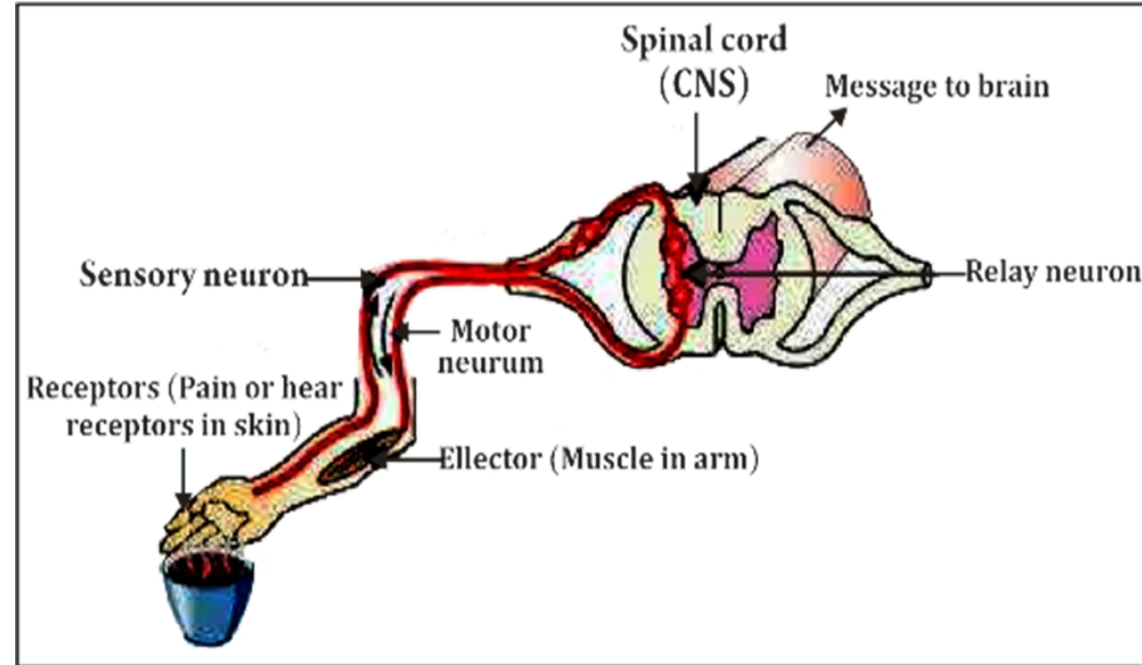
Reflex arc

- Reflex arc consists of (i) sensory receptor (ii) sensory neuron (iii) reflex center (iv) motor neuron (v) effector
- **Receptor**
- Receptor convey sensation to sensor nerve. Sensory nerve conduct sensation to the spinal cord.
- **Reflex center**
- Reflex center is present in the spinal segment. In the reflex center, reflex from sensory neuron is transferred to motor neuron via association



Motor neuron

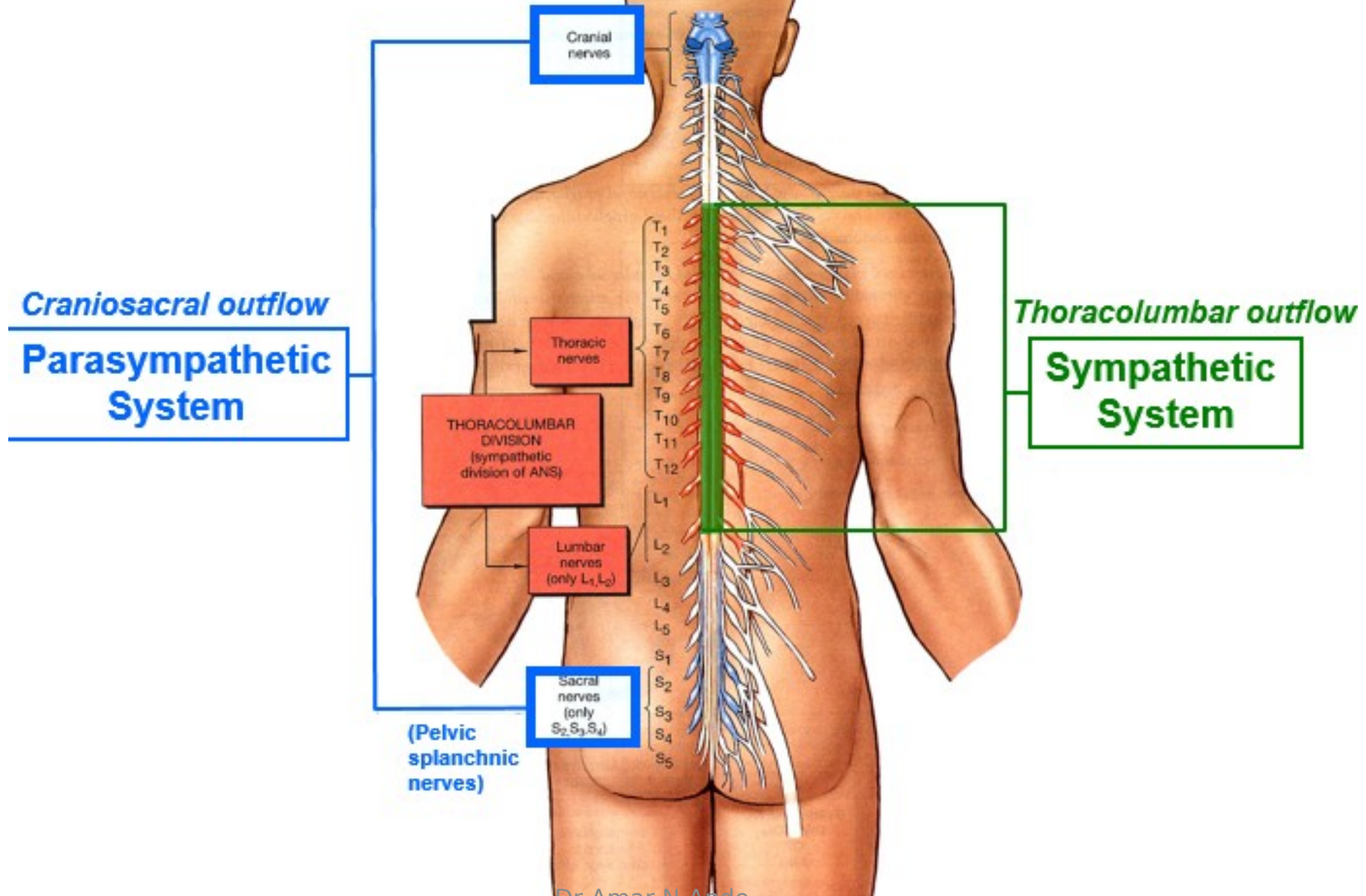
- Association neuron transmits the impulse to motor neuron.
- **Effector**
- Motor neuron conducts motor impulse to effector organ.
- Effector responds to the motor nerve impulse and reflex arc is completed.
- Reflexes which result in the contraction of skeletal muscles are called as **somatic reflexes**.
- Reflexes are carried out by spinal cord are called as **spinal reflexes**.



PHYSIOLOGY OF AUTONOMIC NERVOUS SYSTEM

- Autonomic nervous system regulated activities of glands cardiac muscles and smooth muscles.
- **Autonomic nervous system**
 - Sympathetic – Thoracolumbar outflow
 - Parasympathetic – Cranio sacral outflow
- **Sympathetic nervous system**
- It is also called as **Thoracolumbar nervous system**.
- Cell bodies of sympathetic nerves are located in the lateral gray horns of 12 thoracic segments and first 2 or 3 lumbar segments of spinal cord hence sympathetic nervous system is called as Thoracolumbar outflow.

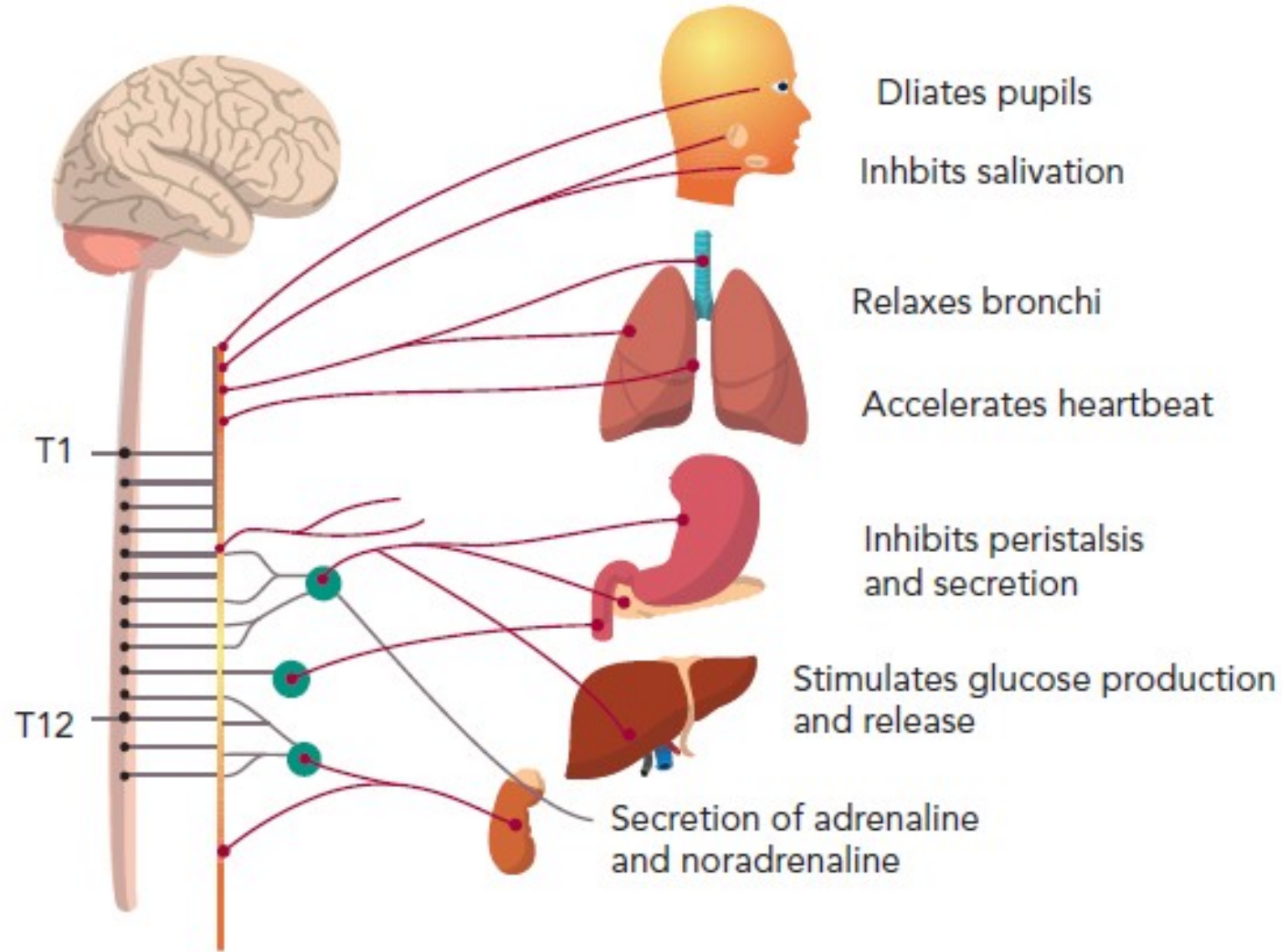
THE AUTONOMIC NERVOUS SYSTEM



FUNCTIONS OF SYMPATHETIC NERVOUS SYSTEM

1. Sympathetic nervous system is concerned with energy expenditure.
2. Stimulation of sympathetic nervous system results in increased heart rate and blood pressure.
3. It increases respiratory rate.
4. Sympathetic nervous system slows down digestion as it inhibits secretion of digestive enzymes.
5. It reduces peristaltic movements.
6. It inhibits secretion of insulin and increases blood sugar level.
7. It reduces urine volume.
8. 07/12/2023 Dilation of pupils.

Sympathetic system



Sympathetic receptors

- Two types of sympathetic receptors are present on the surface of every organ of the body.

1. Alpha receptor
2. Beta receptor

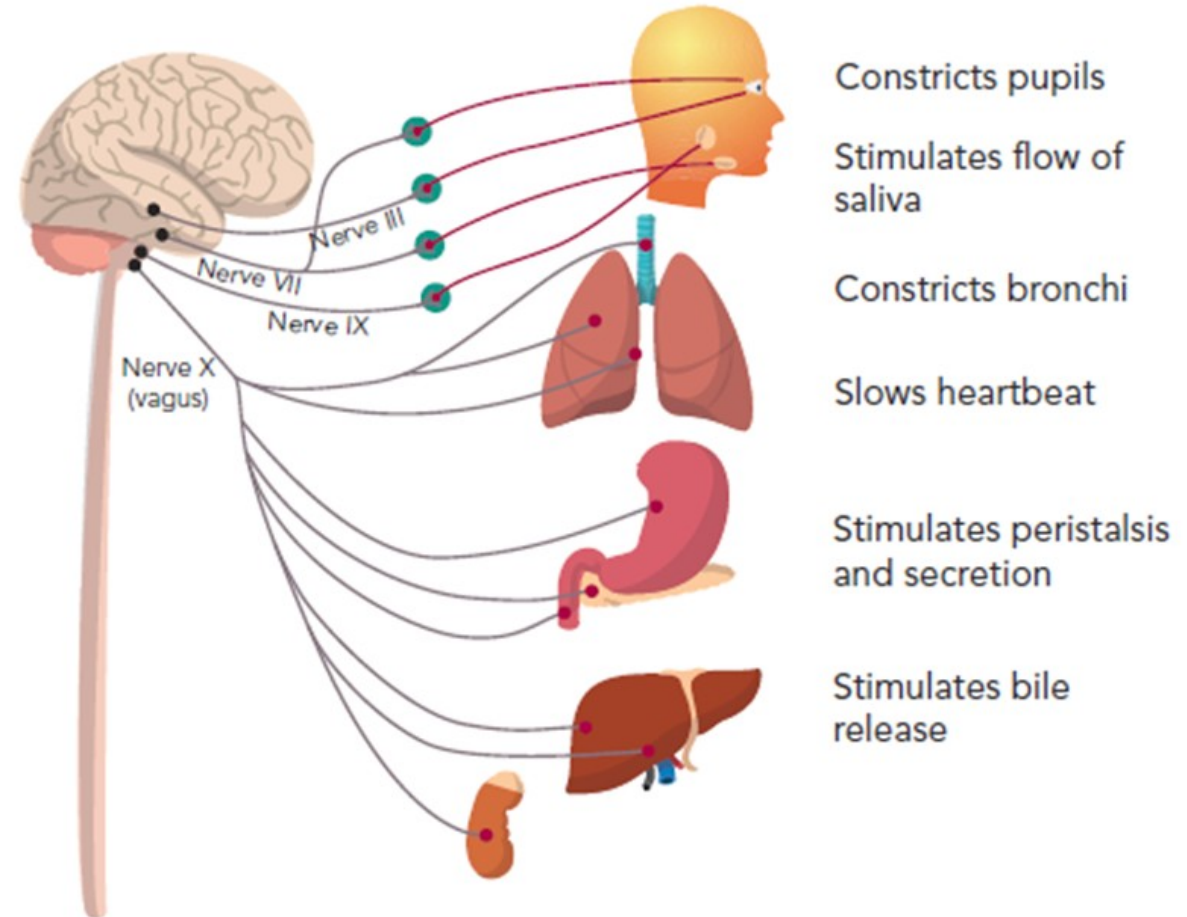
- **Action of Alpha receptors:** Excitatory

- **Action of Beta receptors:** Inhibitory but beta receptors on heart muscles are excitatory hence sympathetic nervous system increases heart rate.

- **Parasympathetic nervous system**

- It is derived from the nuclei in the oculomotor (III), facial nerve (VII) Glossopharyngeal nerve (IX) and vagus nerve (X).
- Sacral outflow of parasympathetic nerve fibres arise from sacral part of spinal cord.

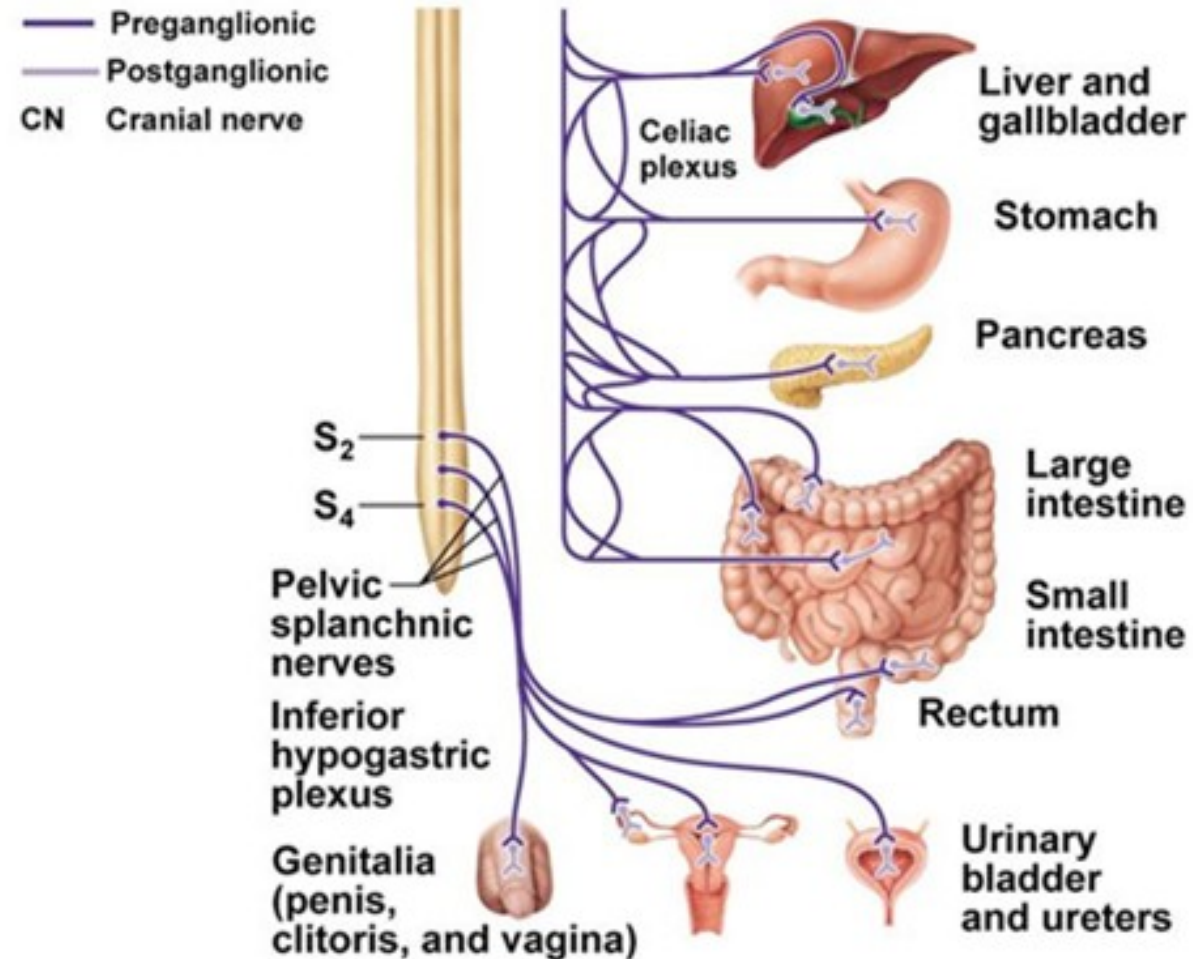
Parasympathetic system

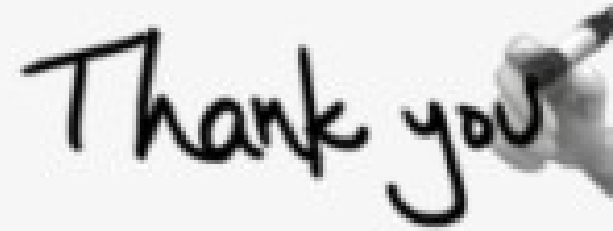


FUNCTIONS OF PARASYMPATHETIC NERVOUS SYSTEM

1. Parasympathetic nervous system is the energy savour system.
2. PNS reduce blood pressure, heart rate and respiratory rate.
3. It stimulates secretion of saliva, digestive juices and insulin.
4. PNS does not have effect on pupils of the eye and urine volume.
5. PNS increases gastric motility and peristaltic movements.
6. It reduces blood sugar level.

Parasympathetic Nervous System (sacral outflow)





Thank you